Vol. 10, No. 3 September, 1953

THE QUEENSLAND JOURNAL OF AGRICULTURAL SCIENCE

COMMONWEALTH INST.
ENTOMOLOGY LIBRARY
- 1 JUL 1954
SERIAL Aus. 40
SEPARATE

CONTENTS

PAGE.

Flock Management to Control Fluorosis of Merino Sheep in Queensland. By J. M. HARVEY 127

Studies of the Coccoidea. 1. New Species of *Neoleonardia*. By A. R. BRIMBLECOMBE 161

An Annotated List of the Scolytidae Occurring in Australia. By A. R. BRIMBLECOMBE 167

PUBLISHED QUARTERLY

By the Queensland Department of Agriculture and Stock, Brisbane

Issued by Direction of Hon. H. H. COLLINS,
Secretary for Agriculture and Stock.

EDITORIAL BOARD.

Chairman and Editor: C. W. WINDERS, B.Sc.Agr., A.C.I.S.

A. L. CLAY, B.V.Sc., Assistant Director, Division of Animal Industry.

J. LEGG, B.Sc., D.V.Sc., M.R.C.V.S., Director of Research, Division of Animal Industry.

E. B. RICE, Dip.Ind.Chem., Director of Dairying, Division of Dairying.

J. H. SIMMONDS, M.B.E., M.Sc., Officer in Charge, Science Branch, Division of Plant Industry.

W. J. S. SLOAN, M.Sc.Agr., Assistant Director of Agriculture, Agriculture Branch, Division of Plant Industry.

J. H. SMITH, M.Sc., N.D.A., Assistant Director of Horticulture, Horticulture Branch, Division of Plant Industry.

A. K. SUTHERLAND, B.V.Sc., M.S., Senior Veterinary Pathologist, Division of Animal Industry.

L. G. VALLANCE, M.Sc., Assistant Director, Bureau of Sugar Experiment Stations.

M. WHITE, Ph.D., M.Sc., A.R.A.C.I., Agricultural Chemist and Biochemist, Chemical Laboratory, Division of Plant Industry.

The Journal is supplied free of charge to organizations and institutions engaged in agricultural science or veterinary science. Application should be made to the Under Secretary, Department of Agriculture and Stock, Brisbane, Queensland, Australia.

THE QUEENSLAND JOURNAL OF AGRICULTURAL SCIENCE

VOL. 10. - - NO. 3.

SEPTEMBER, 1953.

FLOCK MANAGEMENT TO CONTROL FLUOROSIS OF MERINO SHEEP IN QUEENSLAND.

By J. M. HARVEY, M.Sc., Senior Chemist, Biochemical Section, Chemical Laboratory, Division of Plant Industry.

SUMMARY.

An investigation was made to determine how fluorosis in Merino sheep could be alleviated by variations in the time of exposure to and protection from fluorided water. The treatments used were considered in relation to field application under Queensland conditions.

Eighty Merino lambs, in four equal groups, were subjected to the following treatments for 30 months from three months of age:—

Group 1—Continuously exposed to fluorided water.

Group 2—Alternately exposed to and protected from fluorided water for periods of three months.

Group 3—Alternately exposed for six months to and protected for three months from fluorided water.

Group 4—Alternately exposed to and protected from fluorided water for periods of six months.

The animals were kept in small paddocks and their diet was grassy lucerne hay fed in bales together with limited grazing. The fluorided water was prepared to contain 10 p.p.m. F.

Liveweight gains and wool growth were comparable in all groups.

No abnormalities in femur, tibia or mandible were detected.

The lesions of fluorosis were apparent in the incisor teeth of all sheep but were least pronounced in the group alternately exposed to and protected from fluorine for periods of three months. The fluorine concentration in bones and teeth was also least in this group.

As a result of this study, together with findings recorded previously by the author, a system of flock management is recommended. The system is based on the presence or provision of alternative fluorine-free water, but enables the maximum use of fluorided water with the minimum of damage to sheep.

INTRODUCTION.

In an earlier publication (Harvey, 1952) it was stated that in the light of present knowledge the only means of ameliorating chronic endemic fluorosis of Merino sheep in Queensland is by flock management. This conclusion was based on observations on affected properties, where efficient management and the use of fluorine-free water for sheep during their susceptible period were found to reduce fluorotic symptoms greatly.

The object of the investigation now reported was to determine how fluorosis in sheep might be alleviated by variation in the time of exposure to and protection from water containing fluorine.

EXPERIMENTAL.

The experimental animals were Merino lambs three months of age at the beginning of the experiment. They were bred on a property in south-western Queensland from ewes which had not been exposed to water containing fluorine. A uniform line of 80 lambs was selected from 100 brought to Yeerongpilly, and they were divided into four equal groups which were treated as follows:—

Group 1—Continuously on water containing 10 p.p.m.F.

Group 2—Alternately for 3 months on water containing 10 p.p.m.F and 3 months on fluorine-free water.

Group 3—Alternately for 6 months on water containing 10 p.p.m.F and 6 months on fluorine-free water.

Group 4—Alternately for 6 months on water containing 10 p.p.m.F and 3 months on fluorine-free water.

Two paddocks of approximately an acre each were used. In one paddock the sheep had access to water containing less than 0·1 p.p.m.F. In the other paddock the complete drinking supply contained 10 p.p.m.F. This drinking water was prepared in 44-gallon drums by the addition and thorough mixing of the required amount of sodium fluoride. Analyses were made at regular intervals to ensure that the desired concentration of 10 p.p.m.F. was maintained. The 44-gallon storage tanks and the drinking troughs were protected from sun and rain to minimise changes in concentration.

The diet was grassy lucerne hay of poor quality fed in bales. Limited grazing was also available, but this was not extensive, as each paddock averaged approximately 40 sheep to the acre.

All sheep were given anthelmintic treatment with phenothiazine at the commencement and at monthly intervals during the course of the study.

Liveweights and observations on the incisor teeth were recorded at monthly intervals.

The duration of the investigation was 30 months. Six animals from each group were then autopsied. Photographs of the incisor teeth were taken and X-ray plates of the femur, tibia and mandible were made. Kidney, femur, tibia, mandible and incisor, molar and premolar teeth were analysed for fluorine.

The design of the investigation was based on the following considerations:—

(1) Any one of the ameliorative treatments is practicable in endemic areas. On an affected property there may be one or more fluorine-free bores; alternatively, there may be, or could be constructed, earth tanks for the trapping of surface water.

(2) The high level of fluorine (10 p.p.m.F) corresponds with that of badly affected water. This level can occur at the borehead or, more commonly, at a distant portion of a long drain where concentration by evaporation has considerably increased the fluorine content. If any of the systems of intermittent exposure showed beneficial effects in comparison with the continuously exposed group, such effects would be enhanced under less severe conditions.

(3) The use of 3-month-old lambs enabled all groups to be exposed to fluorided water during the period immediately prior to or immediately after early weaning. The systems of management were therefore compared under severe conditions of exposure to affected water.

(4) The rate of stocking of the paddocks meant that the bulk of the diet had to come from the grassy lucerne hay fed in bales. This was arranged to simulate the wear on teeth that occurs under field conditions in endemic areas.

RESULTS.

Tables 1–4 record the observations on the incisor teeth of the sheep in each group. The inspections were made at monthly intervals, so the comments denote the onset of symptoms of fluorosis as judged by damage to the permanent incisors. At the conclusion of the investigation, when the sheep were 33 months of age, all except one sheep had erupted the third pair of incisors and a number had erupted the fourth pair. The severity of the fluorotic lesions on incisor teeth was used to compare treatments.

The mean monthly weights for each group are shown in Fig. 1.

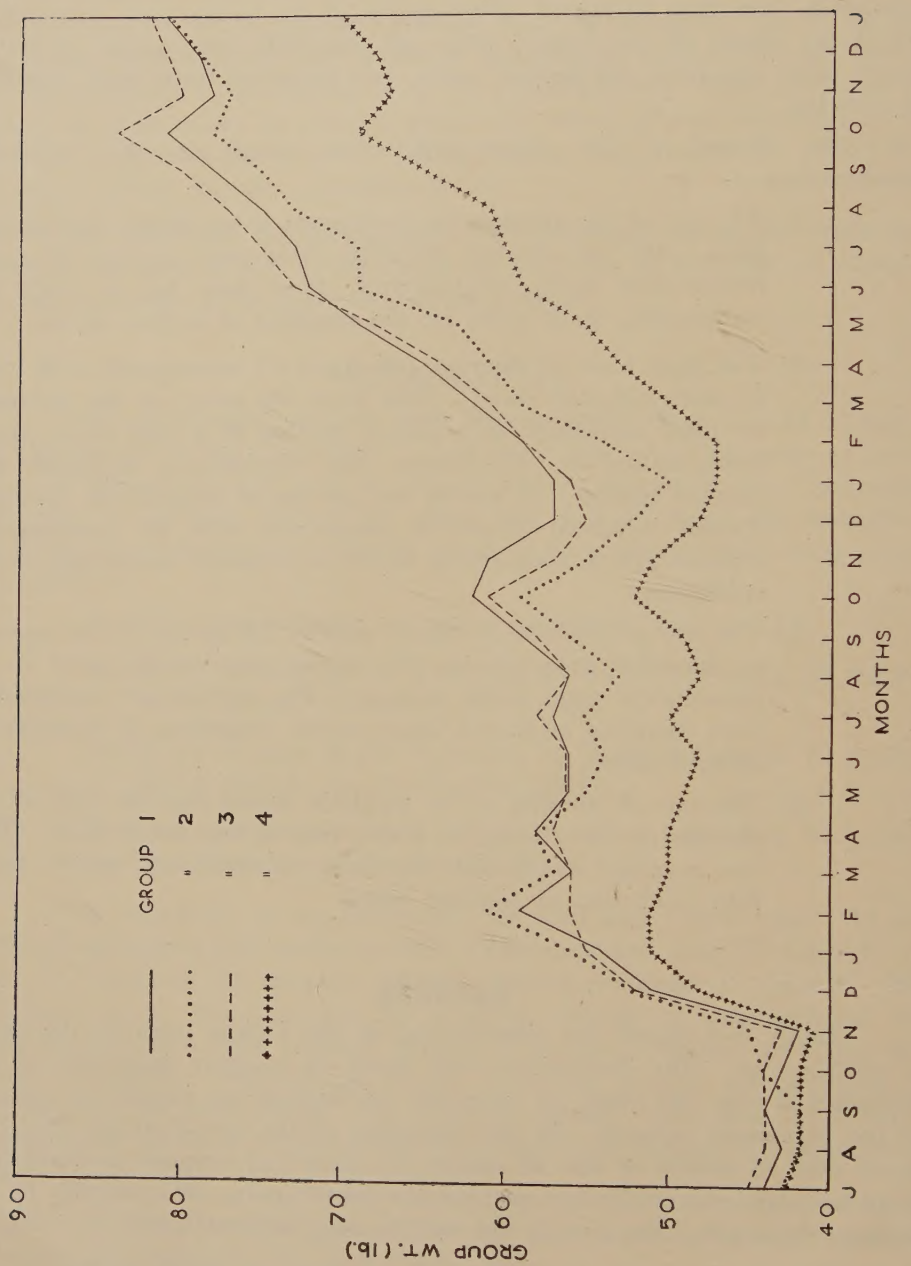

Fig. 1.

Graph Showing Mean Monthly Weight of Sheep in Each Group.

Table 1.

OBSERVATIONS ON INCISOR TEETH OF SHEEP FROM GROUP 1.
(Continuously Exposed Group.)

Age (Months).	Observations.	
	Eruption of Incisors.	Fluorotic Lesions.
3—9	Deciduous teeth only.	
10	1st pair erupting in four sheep.	
11	1st pair in seven sheep.	Overlapped in three sheep; all show erosion, fine chalky striations and chalky spots, staining and some deep pitting.
12	1st pair in nine sheep.	Erosion and chalky striations more pronounced.
13	1st pair in all except three sheep.	Some chipping of cutting surfaces as teeth come into wear.
14	1st pair in all sheep.	Marked chalky striations, erosion and some deep pitting; staining more pronounced; some chipping.
15	1st pair in all sheep.	Increased wear on cutting surfaces.
16	2nd pair erupting in two sheep.	No change.
17	2nd pair in three sheep.	Paper white; deeply eroded, with pronounced chalky bands.
18	2nd pair in eight sheep.	Erosion and chalky striations more pronounced than in 1st pair.
19	2nd pair in all except four sheep.	One deformed incisor arch.
20	2nd pair in all except four sheep.	No change.
21	2nd pair in all except two sheep.	Markedly striated and some chipping; increased wear on 1st pair.
22	3rd pair erupting in two sheep.	No change.
23	2nd pair in all sheep; 3rd pair in two sheep.	All incisors show marked evidence of fluorosis.
24	3rd pair in seven sheep.	All markedly striated, with chalky bands.
25	3rd pair in seven sheep.	No change
26	3rd pair in all except four sheep.	All show marked striations developing to chalky areas; 2nd pair show chalky bands with erosion and pitting to give horizontal lines of weakness; 1st pair show striations and erosion more pronounced in the lower half.
27	3rd pair in all except four sheep.	No change.
28	3rd pair in all except one sheep; 4th pair erupting in two sheep.	No change.
29	3rd pair in all sheep; 4th pair in four sheep.	No change.
30	4th pair in seven sheep.	4th pair deeply eroded and markedly striated; 3rd pair eroded, with some deep pitting and pronounced chalky bands; 2nd pair similar to 3rd pair but cutting surfaces are more worn; 1st pair badly worn, markedly striated over the lower half, with some deep lines of pitting at the gum margin.

Table 2.

OBSERVATIONS ON INCISOR TEETH OF SHEEP FROM GROUP 2.
(Three Months' Exposure and Three Months' Protection.)

Age (Months).	Observations.	
	Eruption of Incisors.	Fluorotic Lesions.
3—9	Deciduous teeth only.	
10	1st pair erupting in one sheep.	
11	1st pair in two sheep.	Fine transverse striations with slight staining.
12	1st pair in six sheep.	Erosion with fine striations and slight staining.
13	1st pair in 12 sheep.	Slight chipping of cutting surfaces.
14	1st pair in all except two sheep	Erosion marked in two sheep only.
15	1st pair in all except one sheep.	Fine striations and some chalky spots ; some chipping.
16	1st pair in all except one sheep.	No change.
17	1st pair in all sheep ; 2nd pair erupting in three sheep.	No change.
18	2nd pair in four sheep.	Fine striations with some erosion.
19	2nd pair in seven sheep.	1st pair show increased wear on cutting surfaces.
20	2nd pair in 11 sheep.	No change.
21	2nd pair in all except three sheep ; 3rd pair erupting in one sheep.	All incisors show fine striations and some erosion emphasised by staining ; 1st pair show wear.
22	2nd pair in all except three sheep ; 3rd pair erupting in one sheep.	No change.
23	2nd pair in all sheep ; 3rd pair in two sheep.	One deformed incisor arch.
24	3rd pair in five sheep.	All incisors tend to be paper white, with fine striations, erosion and staining.
25	3rd pair in five sheep.	No change.
26	3rd pair in seven sheep.	In only three sheep are there evident lesions of fluorosis ; all other sheep in this group are classed as mild cases at this stage.
27	3rd pair in all except six sheep.	No change.
28	3rd pair in all except four sheep ; 4th pair erupting in one sheep.	No change.
29	3rd pair in all except one sheep ; 4th pair erupting in two sheep.	A deformed incisor arch in two sheep ; increased wear on 1st pairs.
30	3rd pair in all sheep ; 4th pair in three sheep.	Three sheep show marked striations with erosion and some deep pitting on 2nd and 3rd pairs ; other sheep in this group show fine striations and mild erosion, with some wear on cutting surfaces.

Table 3.

OBSERVATIONS ON INCISOR TEETH OF SHEEP FROM GROUP 3.
(Six Months' Exposure and Three Months' Protection.)

Age (Months).	Observations.	
	Eruption of Incisors.	Fluorotic Lesions.
3—8	Deciduous teeth only.	
9	1st pair erupting in four sheep.	
10	1st pair in nine sheep.	All show erosion and marked chalky striations.
11	1st pair in 12 sheep.	As at 10 months plus slight chipping of cutting surfaces.
12	1st pair in all except five sheep.	Marked erosion, pronounced tranverse chalky bands, some staining and chipping.
13	1st pair in all except one sheep.	Some deep pitting, increased wear on cutting surfaces.
14	1st pair in all except one sheep.	No change.
15	2nd pair erupting in two sheep.	No change.
16	1st pair in all sheep ; 2nd pair in six sheep.	Paper white, markedly striated, with chalky areas, deeply eroded and 1st pair badly worn ; one deformed incisor arch.
17	2nd pair in 12 sheep.	No change.
18	2nd pair in all except four sheep.	No change.
19	2nd pair in all except three sheep.	As before plus increased wear on 1st pair.
20	2nd pair in all except two sheep.	No change.
21	2nd pair in all except one sheep ; 3rd pair erupting in four sheep.	No change.
22	2nd pair in all sheep ; 3rd pair in six sheep.	All markedly eroded, striated and stained ; 2nd pair show some deep bands of pitting, pronounced chalky areas and increased wear on cutting surfaces.
23	3rd pair in 10 sheep.	No change.
24	3rd pair in all except six sheep.	Marked chalky bands and chalky areas, some deep pitting.
25	3rd pair in all except six sheep.	No change.
26	3rd pair in all except four sheep ; 4th pair erupting in one sheep.	All incisors show marked fluorotic lesions and closely resemble those in sheep from group 1 ; vertical cracks are apparent in the cutting surfaces of 1st and 2nd pairs.
27	3rd pair in all except three sheep ; 4th pair in one sheep.	No change.
28	3rd pair in all except two sheep ; 4th pair in six sheep.	One 1st incisor broken at line of pitting.
29	3rd pair in all except one sheep ; 4th pair in 11 sheep.	No change.
30	3rd pair in all sheep ; 4th pair in all except five sheep.	All incisors show marked evidence of fluorosis ; 1st pair broken in two sheep ; four sheep have a deformed incisor arch.

Table 4.

OBSERVATIONS ON INCISOR TEETH OF SHEEP FROM GROUP 4.
(Six Months' Exposure and Six Months' Protection.)

Age (Months).	Observations.	
	Eruption of Incisors.	Fluorotic Lesions.
3—9	Deciduous teeth only.	
10	1st pair erupting in two sheep.	
11	1st pair in seven sheep.	All show erosion, fine chalky striations and slight staining.
12	1st pair in all except three sheep.	No change.
13	1st pair in all except one sheep.	All show erosion, pitting and chalky bands.
14	1st pair in all except one sheep.	No change.
15	1st pair in all sheep.	As before plus increased wear on cutting surfaces.
16	1st pair in all sheep.	No change.
17	2nd pair erupting in three sheep.	No change.
18	2nd pair in six sheep.	All show erosion and chalky striations; some deep pitting on 1st pair and worn cutting surfaces; one deformed incisor arch.
19	2nd pair in six sheep.	No change.
20	2nd pair in all except four sheep.	Increased wear on 1st pair.
21	2nd pair in all except three sheep.	No change.
22	2nd pair in all sheep.	Eroded, with some deep pitting, finely striated, with chalky bands in three sheep.
23	3rd pair erupting in three sheep.	No change.
24	3rd pair in four sheep.	Eroded, striated and stained.
25	3rd pair in five sheep.	No change.
26	3rd pair in all except six sheep.	The fluorotic lesions are more marked in this group than in group 2, but less severe than in groups 3 and 1.
27	3rd pair in all except three sheep.	No change.
28	3rd pair in all except three sheep.	No change.
29	3rd pair in all except two sheep; 4th pair in four sheep.	No change.
30	3rd pair in all except one sheep; 4th pair in four sheep.	All incisors are eroded and finely striated, with chalky bands in three sheep; some wear on cutting surfaces of 1st and 2nd pairs; one deformed incisor arch.

Table 5 records the fluorine concentration in kidney, femur, tibia, mandible, and incisor, premolar and molar teeth. The analyses were made on specimens from six sheep from each group taken after autopsy at 33 months of age, and the fluorine levels reported are the means of the six determinations for each of the groups.

Table 5.

FLUORINE CONCENTRATION IN KIDNEY, BONES AND TEETH.
(p.p.m.F on Dry Matter Basis, Fat-free Bones and Teeth.)

Group No.	Sheep No.	Tissue.										
		Kidney.	Femur.	Tibia.	Mandible.	1st pair.	2nd pair.	3rd pair.	4th pair.	3rd premolar.	2nd molar.	3rd molar.
1	1	100	2400	1840	2800	1400	1600	1500	1450	1760	1280	1520
	2	16	2080	1280	2960	960	1400	1350	1600	1400	1120	1280
	3	16	2640	1680	2960	1480	1760	1650	1600	1600	1440	1680
	4	24	2000	1440	2720	1120	1600	1520	1450	1360	1360	1360
	5	24	2000	1680	2720	1520	1200	1250	1300	1480	1520	1480
	6	10	2240	1760	3280	1680	1440	1420	1800	1520	1440	1440
	Mean	32	2227	1613	2907	1360	1500	1448	1533	1520	1360	1460
2	1	52	1280	1040	1520	880	640	850	850	1040	880	1040
	2	12	1080	1000	1200	560	560	650	600	840	800	800
	3	16	1440	960	1360	680	760	800	700	800	720	720
	4	10	880	720	920	600	560	650	650	720	500	680
	5	10	1280	1040	1520	680	760	730	..	840	720	840
	6	16	1200	800	1120	720	800	720	620	720	800	640
	Mean	19	1193	927	1273	687	680	733	684	827	737	787
3	1	56	2080	1360	2320	1040	1120	1200	1700	1200	1160	1240
	2	10	1840	1200	2150	1240	1440	900	1400	1360	1240	1040
	3	10	2160	1840	2240	1120	1240	1100	1080	1320	720	1200
	4	10	1520	1040	2080	1330	960	900	1400	1040	960	880
	5	24	2080	1600	2160	1280	1360	1140	1200	1360	1400	1560
	6	28	1920	1440	2320	1320	1680	1750	1500	1120	1280	1520
	Mean	23	1933	1413	2212	1225	1300	1165	1380	1233	1127	1240
4	1	20	1520	880	1600	920	880	700	..	840	840	880
	2	12	1200	880	1680	960	1200	1000	1600	1000	1000	1080
	3	12	1520	1040	1480	920	720	700	1100	720	1080	680
	4	10	1520	800	1600	750	760	1000	1000	840	840	720
	5	20	1680	1280	1680	1000	920	900	1200	960	680	880
	6	24	1440	1040	1600	800	640	750	1100	720	1200	880
	Mean	16	1480	987	1607	892	853	842	1200	847	940	853

Photographs of the incisor teeth of six sheep from each group taken after autopsy are shown in Figs. 2–5.

Fig. 2 shows the left half of the incisor arch of sheep from group 1. The changes in tooth structure, described as transverse chalky striations, were apparent in all specimens from this group, but such lesions are not clearly defined in photographic reproductions. Some deep pitting is apparent and is emphasised by staining. Splaying of the incisors is noticeable in sheep 2; sheep 5 and 6 show marked crowding with the 4th pair of incisors erupted at right angles. Some chipping of the cutting surfaces of the 1st pair can be seen in sheep 1 and 5.

Fig. 2.

Left Half of the Incisor Arch of Sheep in Group 1.

Fig. 3 shows the left half of the incisor arch of sheep from group 2. Abnormalities in tooth structure are not readily apparent in animals from this group; chalky striations occurred but are not reproduced in the photographs. There has been some mottling, emphasised by staining. Chipping of the cutting surfaces is noticeable, and there are horizontal fractures close to the cutting edges. Erosion and pitting are less severe than in the other three groups.

Fig. 3.

Left Half of the Incisor Arch of Sheep in Group 2.

Fig. 4 shows the left half of the incisor arch of sheep from group 3. Chalky striations may be discerned in each photograph. "Sheet" erosion and some deep pitting are emphasised by staining. Horizontal lines of weakness are indicated, and the 1st pair of incisors in sheep 1 have snapped off at one of the lines of weakness. Damage to the cutting surfaces is shown, particularly in sheep 1, 4 and 6.

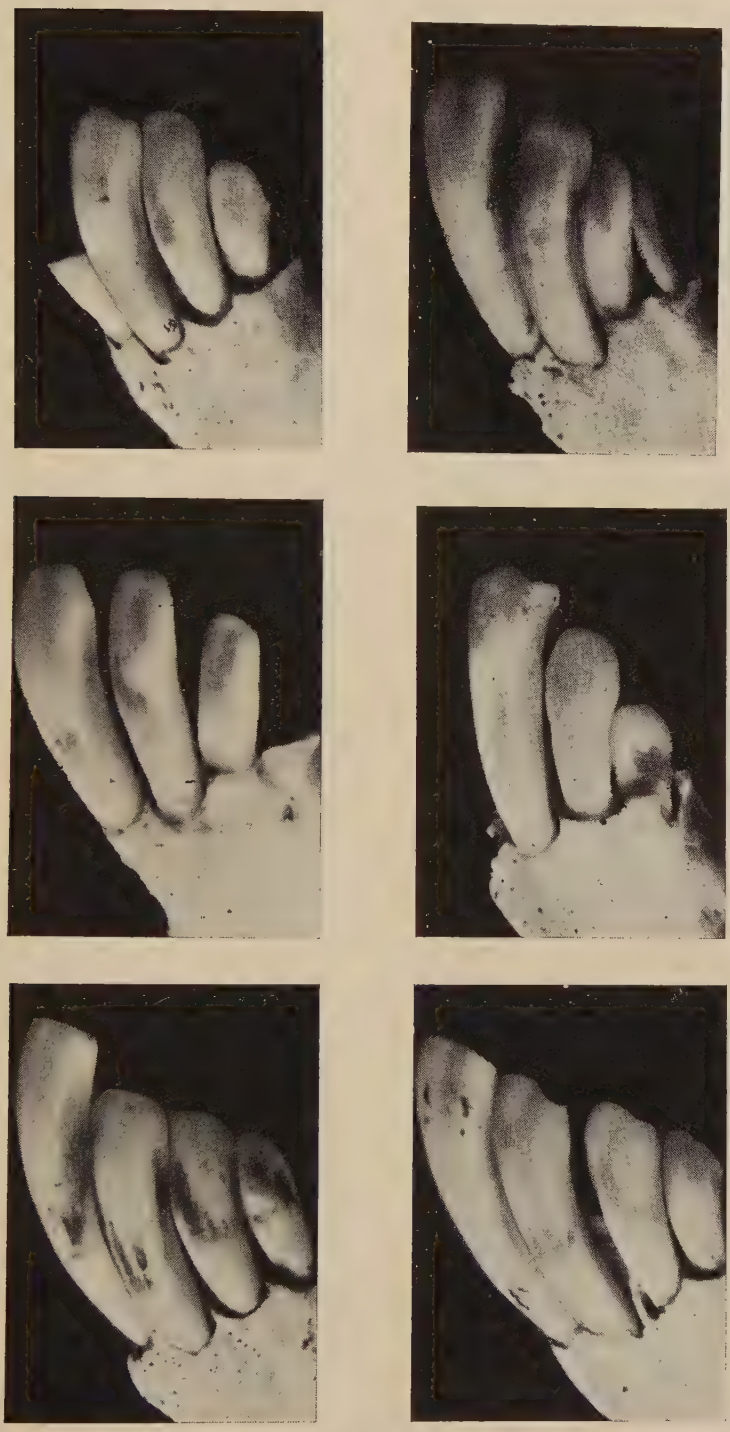

Fig. 4.

Left Half of the Incisor Arch of Sheep in Group 3.

Fig. 5 shows the left half of the incisor arch of sheep from group 4. Chalky transverse striations are apparent. Erosion and some deep pitting are emphasised by staining. Chipping of the cutting surfaces is noticeable in sheep 4, and there are some horizontal fractures towards the cutting edges.

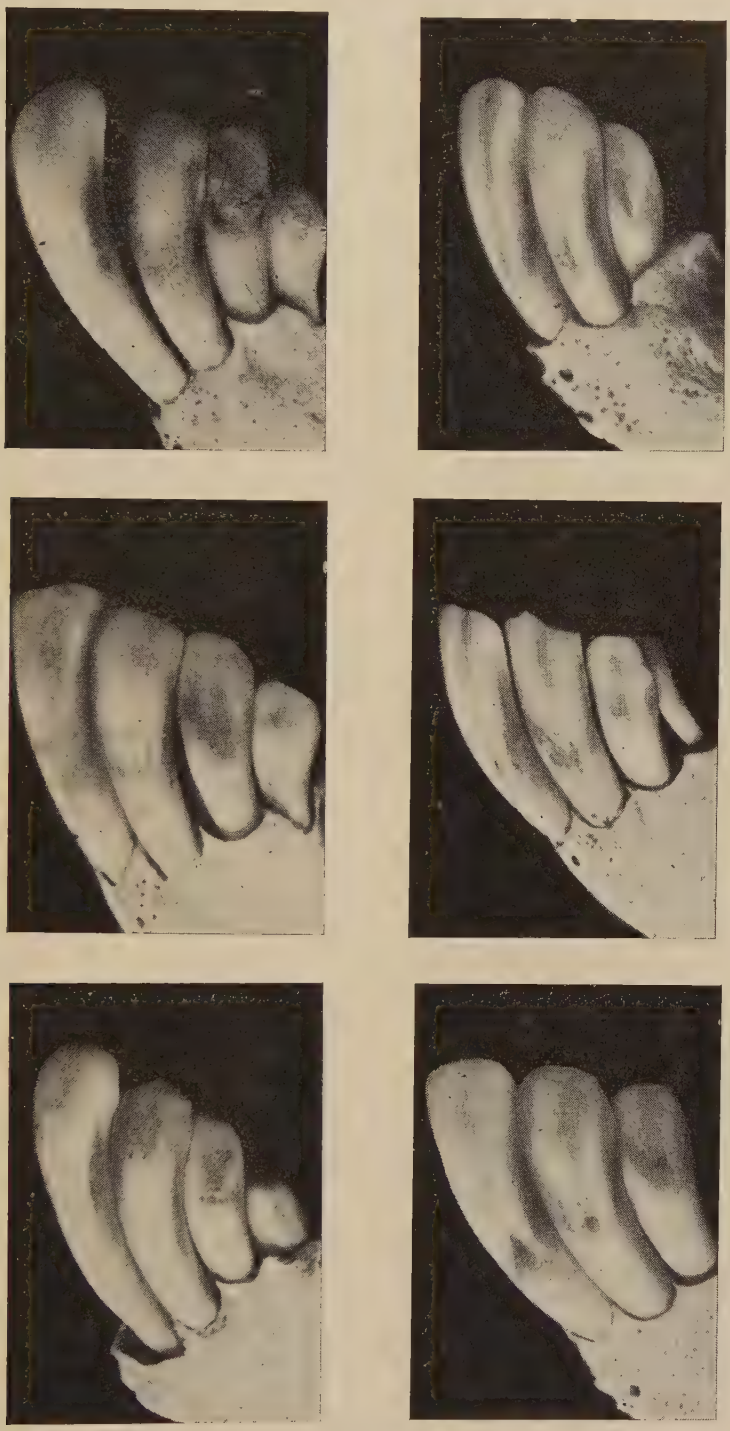

Fig. 5.

Left Half of the Incisor Arch of Sheep in Group 4.

X-ray photographs are shown in Figs. 6–29. These are of the mandible, femur and tibia of all animals slaughtered at the end of the investigation.

Figs. 6–11 show the mandible, femur and tibia of six sheep from group 1. In all cases there is good deposition of dense bone. There is some indication of uneven wear on molar and premolar teeth in four of the six photographs.

Figs. 12–17 show the mandible, femur and tibia of six sheep from group 2. No abnormalities are detectable.

Figs. 18–23 show the mandible, femur and tibia of six sheep from group 3. In four of the six photographs the dense bone appears thinner directly under the 3rd molar, and there is a tendency for the roots of this molar to extend into the compact substance. Some uneven wear on molar and premolar teeth is discernible in two photographs from this group.

Figs. 24–29 show the mandible, femur and tibia of six sheep from group 4. In two of the specimens some uneven wear of molar and premolar teeth is apparent.

DISCUSSION.

Examination of Tables 1–4 shows that fluorotic lesions were discernible in the incisor teeth of all the experimental animals. The severity of these lesions varied between animals within a group, but the variations were not large when compared with group differences. These findings support the following conclusions:—

(1) The maximum damage was in group 1, the continuously exposed group.

(2) The minimum damage resulted in group 2, the group alternately exposed and protected for periods of three months.

(3) The lesions in group 3, the group alternately exposed for six months and protected for three months, closely resembled those in group 1.

(4) The lesions in group 4, the group alternately exposed and protected for periods of six months, were intermediate in severity between those in group 3 and group 2.

The analytical data in Table 5 support the conclusion that, for these experimental animals, there is a relationship between fluorine storage in bones and teeth and the severity of the fluorotic lesions in incisor teeth. The maximum damage and the maximum fluorine storage occurred in the continuously exposed animals (group 1). The minimum damage and the minimum fluorine storage were found in group 2, the group alternately exposed and protected for periods of three months. The fluorine storage in bones and teeth in group 3, the group exposed for six months and protected

for three months, closely resembles that in group 1; the severity of the dental lesions in group 3 supports this finding. The fluorine levels in bones and teeth of sheep in group 4, the group alternately exposed and protected for periods of six months, are intermediate between those of group 3 and group 2. The fluorotic lesions in incisor teeth of group 4 are also intermediate in severity between those of group 3 and group 2.

Examination of the photographs of the incisor teeth at the end of the investigation support the conclusions drawn from the monthly examination of incisor teeth and the analytical data on fluorine storage in bones and teeth. The characteristic transverse chalky striations are not clearly depicted by monochrome photography but may be discerned in photographs of all groups other than group 2. Erosion and pitting are also less apparent in the photographs of specimens from group 2. Horizontal lines of weakness were present in the incisors from sheep in groups 1 and 3. This is emphasised in sheep 1 from group 3 (Fig. 4) in which the 1st incisor has snapped at a line of weakness. The only marked damage from exposure to fluorine of sheep in group 2 is the chipping and fractures at the cutting surfaces of incisor teeth. Such defects are also apparent in the incisor teeth of sheep in other groups.

The X-ray photographs of the mandible, femur and tibia (Figs. 6–29) do not indicate the bone rarification noted in previous studies (Harvey, 1952). There appears to have been a satisfactory deposition of dense bone in the femur and tibia of sheep of all groups. There is no indication of the shortening of the horizontal ramus of the mandible that was apparent in earlier studies. In four of the specimens from group 3 depicted in Figs. 18–23 the layer of dense bone tends to be thinner under the 3rd molar, and the roots of this molar extend into the compact substance. This abnormality was clearly evident in penned sheep exposed to drinking water containing fluorine during earlier investigations on the effect of dietary factors on the incidence of symptoms of fluorosis. There is no evidence of uneven wear on molar and premolar teeth in the specimens from group 2 depicted in Figs. 12–17, but there is an indication of uneven wear of teeth in some specimens illustrated in Figs. 6–11, 18–29.

In the previous studies and in this investigation, some groups were continuously exposed from the age of three months to drinking water containing 10 p.p.m.F. In the earlier studies the animals were housed in pens and fed chaffed or milled food. In the present investigation the animals were kept in small paddocks and had access to limited grazing plus hay fed in bales. The marked evidence of bone rarification in the former study and the equally strong evidence of normal bone deposition in the present investigation could be the effect of fluorine on sheep under different conditions of housing and feeding.

Fig. 6.
Mandible, Femur and Tibia of Sheep from Group 1.

Fig. 7.
Mandible, Femur and Tibia of Sheep from Group 1.

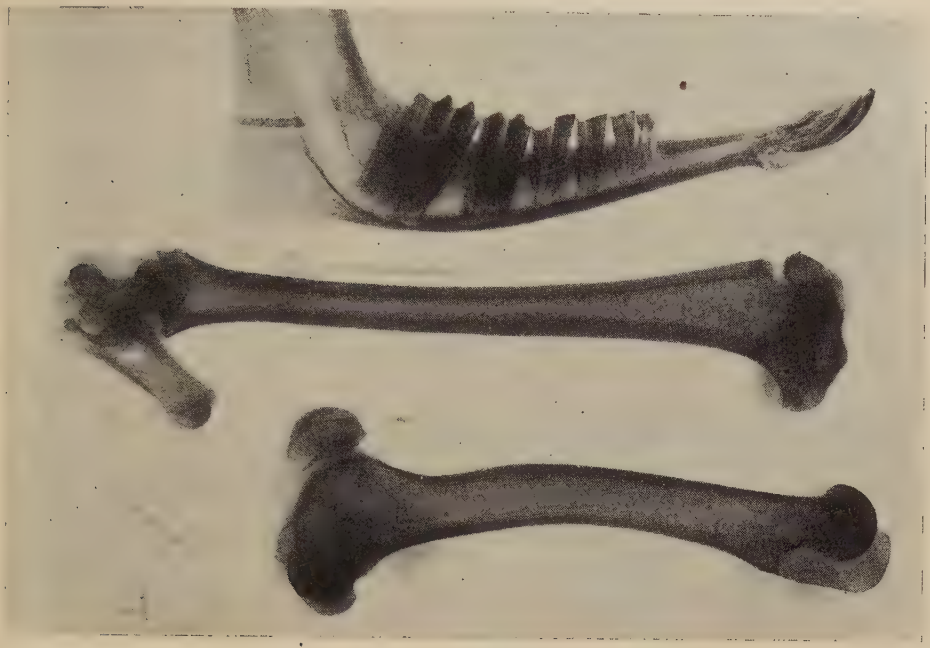

Fig. 8.
Mandible, Femur and Tibia of Sheep from Group 1.

Fig. 9.
Mandible, Femur and Tibia of Sheep from Group 1.

Fig. 10.
Mandible, Femur and Tibia of Sheep from Group 1.

Fig. 11.
Mandible, Femur and Tibia of Sheep from Group 1.

Fig. 12.
Mandible, Femur and Tibia of Sheep from Group 2.

Fig. 13.
Mandible, Femur and Tibia of Sheep from Group 2.

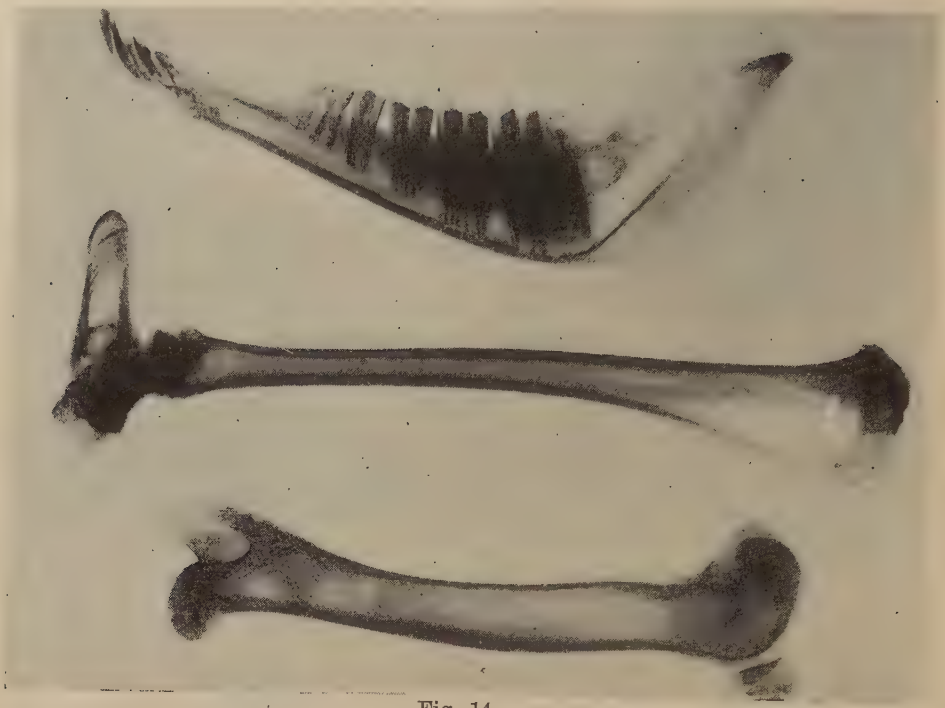

Fig. 14.
Mandible, Femur and Tibia of Sheep from Group 2.

Fig. 15.
Mandible, Femur and Tibia of Sheep from Group 2.

Fig. 16.
Mandible, Femur and Tibia of Sheep from Group 2.

Fig. 17.
Mandible, Femur and Tibia of Sheep from Group 2.

Fig. 18.
Mandible, Femur and Tibia of Sheep from Group 3.

Fig. 19.
Mandible, Femur and Tibia of Sheep from Group 3.

Fig. 20.

Mandible, Femur and Tibia of Sheep from Group 3.

Fig. 21.

Mandible, Femur and Tibia of Sheep from Group 3.

Fig. 22.
Mandible, Femur and Tibia of Sheep from Group 3.

Fig. 23.
Mandible, Femur and Tibia of Sheep from Group 3.

Fig. 24.
Mandible, Femur and Tibia of Sheep from Group 4.

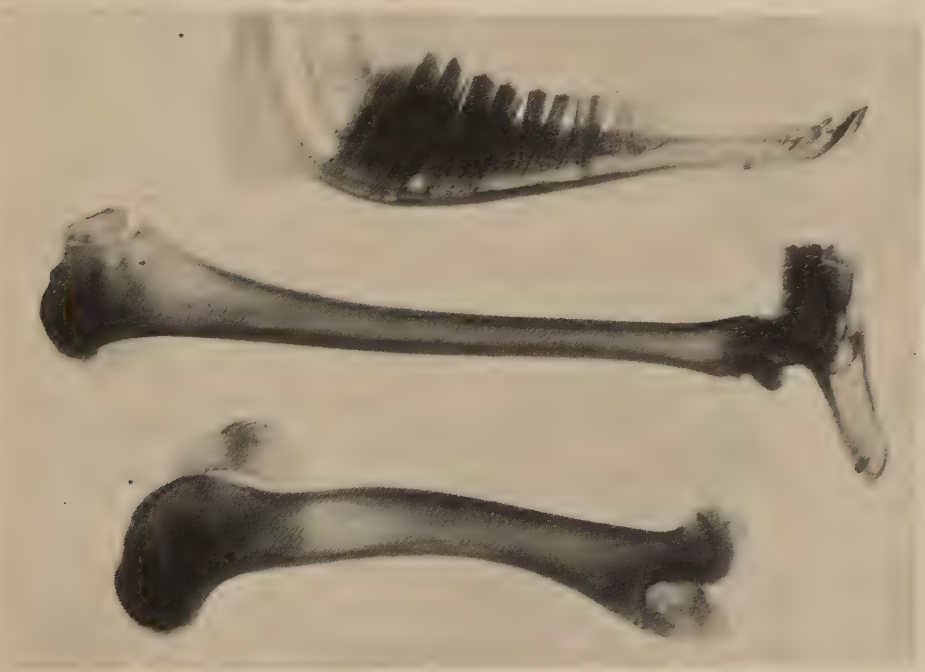

Fig. 25.
Mandible, Femur and Tibia of Sheep from Group 4.

Fig. 26.
Mandible, Femur and Tibia of Sheep from Group 4.

Fig. 27.
Mandible, Femur and Tibia of Sheep from Group 4.

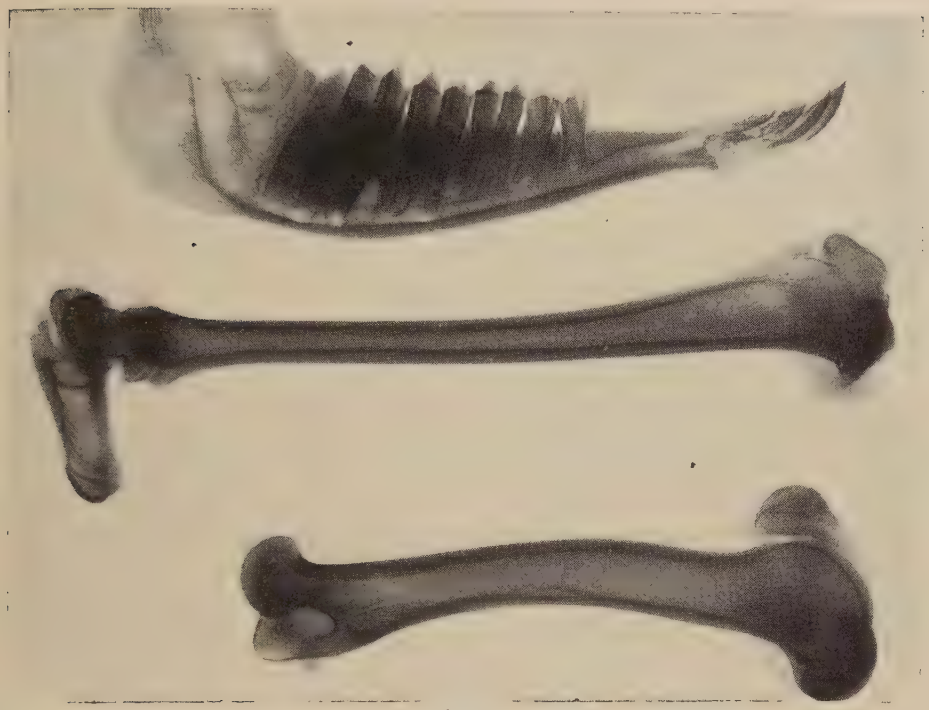

Fig. 28.
Mandible, Femur and Tibia of Sheep from Group 4.

Fig. 29.
Mandible, Femur and Tibia of Sheep from Group 4.

CONCLUSIONS.

Sheep in all groups showed the characteristic fluorotic lesions in the incisor teeth. The damage was most marked in group 1 (continuously exposed to 10 p.p.m.F in the drinking water) and in group 3 (exposed 6 months and protected 3 months). Only in group 2 (exposed 3 months and protected 3 months) were the dental lesions classed as indicating mild fluorosis. There was an indication of uneven wear of molars and premolars in some sheep from all groups other than group 2. The analyses of bones and teeth showed that fluorine storage agreed with these findings. The fluorine concentration in femur, tibia, mandible and teeth was lowest in group 2.

Weight gains and wool growth were similar for all groups. This indicated that up to 30 months' exposure to 10 p.p.m.F in the drinking water did not impair the ability of these animals to gather and masticate grassy lucerne hay of poor quality fed in bales. This is not true for sheep under the same conditions of exposure to fluorine in endemic areas of Queensland—the wear on both incisor and molar teeth is more severe, fractures of the incisors at lines of weakness occur when harsh stubble-like pasture constitutes the bulk of available feed, and production records are unsatisfactory.

Under the experimental conditions, horizontal lines of weakness were apparent in groups 1 and 3, and in two sheep from group 3 fractures of the 1st pair of incisors had occurred. While it might be anticipated that further snapping at lines of weakness would have resulted on continuation of the exposure period, a satisfactory comparison of treatments was possible at the end of 30 months. The treatment most successful in combating the onset of fluorotic lesions was the alternate exposure to and protection from fluorided water for periods of three months.

These findings offer a practical method for the control of endemic fluorosis in Queensland. This control is dependent on either the presence of one or more fluorine-free bores on an affected property or the use of earth tanks or dams for storage of surface water. On the basis of this and previous studies on fluorosis in Merino sheep, recommendations are made for the management of flocks on affected properties.

RECOMMENDATIONS.

(1) Breeding sheep may be held on fluorided water containing up to 10 p.p.m.F. This will not result in an appreciable transmission of fluorine to the lamb, either through foetal circulation or later through the milk.

(2) Either lambs must be weaned early, or ewes and lambs must be transferred to paddocks watered only by fluorine-free water. This transfer must be made before the lambs commence to drink water.

(3) A rotation must be made so that young sheep are protected from fluorided water for a minimum of three months and when exposed do not have access to fluorided water for more than three months.

(4) Sheep over 30 months of age (i.e., when the 3rd pair of incisors are in wear) may be held on paddocks watered by water containing up to 10 p.p.m.F.

As a temporary measure, on properties where no alternative fluorine-free water is available, the harmful effects of fluorine will be minimised if young sheep are watered as near to the borehead as possible. In good or flush seasons, control measures are less important, as the animal will receive the bulk of its fluid requirements from the pasture. These measures afford only a partial relief, and the ultimate control of fluorosis, in areas where all artesian water is affected, involves the storage and economic use of surface water.

ACKNOWLEDGMENTS.

Indebtedness is acknowledged to Dr. John Legg (Director of Research) for housing and feeding facilities for the experimental animals at the Animal Health Station, Yeerongpilly; to Mr. A. K. Sutherland (Senior Veterinary Pathologist) for clinical and post-mortem assistance; to Professor T. K. Ewer and Mr. A. McDowall (Queensland University Veterinary School) for the X-ray photographs; to the late Mr. Thompson (Queensland University Photographer) for photographs of incisor teeth; and to Dr. M. White (Agricultural Chemist of the Department of Agriculture and Stock) for his continuous help and guidance in the course of this study.

REFERENCE.

HARVEY, J. M. 1952. Chronic endemic fluorosis of Merino sheep in Queensland. Qld. J. Agric. Sci. 9: 47-141.

STUDIES OF THE COCCOIDEA. 1. NEW SPECIES OF NEOLEONARDIA.

By A. R. BRIMBLECOMBE, M.Sc., Entomologist, Science Branch, Division of Plant Industry.

SUMMARY.

Examination of the Coccoidea occurring in Queensland has revealed several new species. Two of these, Neoleonardia chitinosa and N. aliformis have now been described.

INTRODUCTION.

Many of the Coccoidea are of economic importance in Queensland, and while elucidating the species and recording their hosts it has become evident that a better understanding of the systematics of this superfamily is essential. Examination of the large amount of material available has revealed a number of new species. In preparation for more extensive publications based on work with these insects, two new species in the tribe Aspidiotini are now described.

GENUS NEOLEONARDIA MacGILLIVRAY.

The genus *Neoleonardia* in the tribe Aspidiotini family Diaspididae was established by MacGillivray (1921, p. 392) to accommodate one species, *Aspidiotus extensus* Maskell (1894, p. 41) of Australia. Two other species—*A. alatus* Froggatt (1914, p. 132) and *A. delicatulus* Laing (1929, p. 23)—were later referred to it by Ferris (1938, p. 43). Two new species from Queensland are now added. The total number of species therefore is five and all are limited to Australia.

For the purpose of comparing illustrations of the described species with those of the new species, reference may be made to the articles of Laing (*loc. cit.*) and Ferris (*loc. cit.*).

Neoleonardia chitinosa n.sp.

(Figs. 1–3.)

Hosts and Distribution.—Type material collected from *Eucalyptus crebra* F. Muell., Inglewood, Sept. 1940, by the author. Paratype material is labelled "*Euc. transcontinalis,* Euston, N.S.W., 25.10.28, W.W.F." This host name is a misspelling of *Eucalyptus transcontinentalis* Maiden.

Habit.—Insect and scale occurring under the epidermis of twigs and branches and giving the appearance of small round surface swellings, averaging 1·5 mm. in diameter. Pellicles are black internally, hard and brittle.

Recognition Characters.—Adult female broadly turbinate with a cephalic constriction, length 1·2 mm. Old specimens as wide as long. Pygidium broad basally. Median lobes completely fused, triangular, margin smooth with a

convexity near base; basal scleroses divided, longer than the lobes. Second lobe small, triangular, with basal sclerosis. Third lobe a mere point but obvious by the basal sclerosis. Paraphyses arising from each of the first and second interlobal spaces, sides subparallel, three times longer than the median basal sclerosis. Plates represented in both the first and second interlobal spaces by two subequal apically curved truncated simple derm processes. Spines as a pair anterior to each of the second and third lobes, with others spaced on the anterior margin of the pygidium. Macroduct openings small, as rows in the second and third duct furrows, approximating 30 and 20 respectively. Perivulvar scleroses in a crescent anterior to the anus. Anus small, nearer to the perivulvar scleroses than to the median lobes. Perivulvar pores absent. Sclerotized thickenings radiate from the apex.

Note.—This species differs from all others in the genus by the presence of three pairs of pygidial lobes.

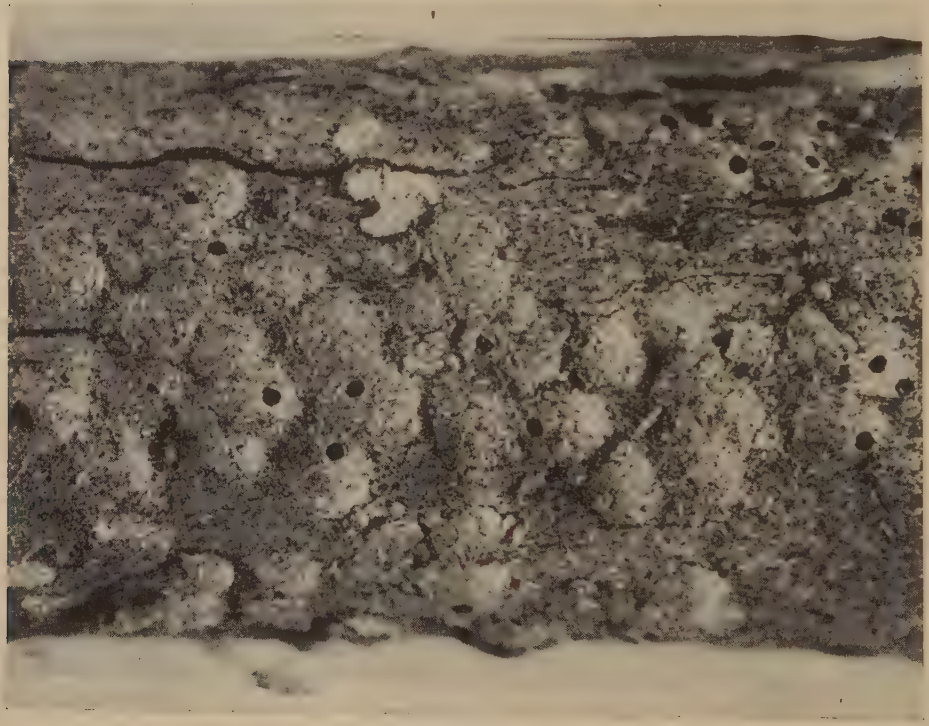

Fig. 1.

Neoleonardia chitinosa n.sp. Appearance of insect on host plant. (× 7.)

Female nymphs apparently settle in positions where host growth is active. The surface tissue surrounding the nymph enlarges slightly, enabling the insect body to expand beneath the epidermal layer, with the first pellicle as a cover to the opening. In normal material this pellicle is not obvious,

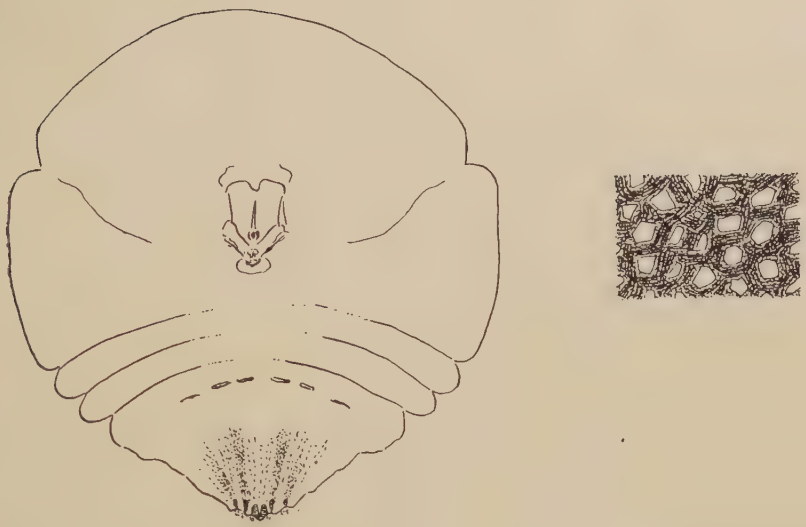

Fig. 2.

Neoleonardia chitinosa n.sp. Left, Outline of adult female. (× 50.)
Right, Enlargement of portion of body surface.

[*Drawing by William Manley.*

Fig. 3.

Neoleonardia chitinosa n.sp. Enlargement of pygidium. (× 190.)

[*Drawing by William Manley.*

but when weathered off or otherwise removed exposes a small oval black area which is part of the upper surface of the second pellicle. When mature specimens are removed, a depression is left in the epidermis of the host.

Old mature females of this species can be readily recognized when mounted for microscopic examination by a dense reticulate chitinization of the prepygidial part of the body (Fig. 2); hence the specific name.

Type slide Reg. No. T.5278, paratype slide (T.5279) and unmounted material (T.5284) are in the Queensland Museum. Paratype slide and unmounted material are in the C.S.I.R.O. collection, Canberra.

Neoleonardia aliformis n.sp.

(Figs. 4–6.)

Host and Distribution.—Type material collected from *Eucalyptus acmenioides* Schau., Brisbane, 26.1.47, by the author.

Habit.—Insect and scale occurring on the smooth bark of small branches or under the stringy bark of the larger branches and trunk. Pellicles dark, hard and brittle.

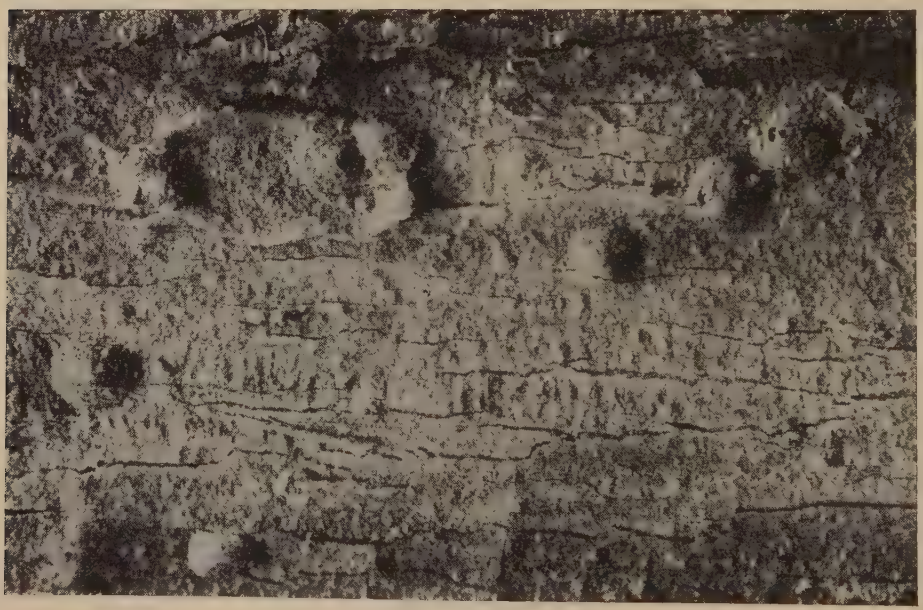

Fig. 4.

Neoleonardia aliformis n.sp. Appearance of insect on host plant. (× 7.)

Recognition Characters.—Adult female ovate, 1·2 mm. long, 0·9 mm. wide; with a small cephalic constriction. Old specimens subcircular. Pygidium very broad basally. Median lobes completely fused and apically

Fig. 5.

Neoleonardia aliformis n.sp. Outline of adult female. (× 50.)

[*Drawing by William Manley.*

Fig. 6.

Neoleonardia aliformis n.sp. Enlargement of pygidium. (× 160.)

[*Drawing by William Manley.*

rounded. Basal scleroses divided, twice the lobe length. Other lobes absent. A large pitted alar expansion on the anterior pygidial margin with irregularly placed pores. A single paraphysis arising from each of the first and second interlobal spaces, four times the length of the media basal sclerosis. Plates represented in the first and second interlobal spaces by two subequal apically curved truncated simple derm processes. A pair of spines anterior to each pair of plates and another pair in the angle made by the alar expansion. Macroduct openings small, as rows in the second and third duct furrows, approximating 20 and 25 respectively. Anus small, centrally placed between median lobes and perivulvar scleroses or slightly nearer the lobes. Perivulvar scleroses in a crescent. Perivulvar pores absent. Sclerotic thickenings radiate from the apex.

Notes.—This species resembles *delicatulus* (as illustrated by Laing, 1929) in having the large pitted alar pygidial expansion, but differs in that the pores on this area are irregularly placed, the postalar and prealar spur-like processes are absent, the large pygidial median pear-shaped chitinous area is not conspicuous and the first plate is represented by a curved pair of processes.

Type slide Reg. No. T.5280 and paratype slides Reg. Nos. T.5281, T.5282, T.5283 in the Queensland Museum.

REFERENCES.

Ferris, G. F. 1938. Contributions to the knowledge of the Coccoidea (Homoptera) VII. Microentomology 3: 17-32.

Froggatt, W. W. 1914. A descriptive catalogue of the scale insects (Coccidae) of Australia. Agric. Gaz. N.S.W. 25: 127-36.

Laing, F. 1929. Report on Australian Coccidae. Bull. Ent. Res. 20: 15-37.

MacGillivray, A. D. 1921. The Coccidae. Urbana, Illinois: Scarab Company.

Maskell, W. M. 1894. Further Coccid notes: with descriptions of new species from New Zealand, Australia, Sandwich Islands and elsewhere and remarks upon many species already reported. Trans. N.Z. Inst. 27: 36-75.

AN ANNOTATED LIST OF THE SCOLYTIDAE OCCURRING IN AUSTRALIA.

By A. R. BRIMBLECOMBE, M.Sc., Entomologist, Science Branch,
Division of Plant Industry.

SUMMARY.

A review has been made of the Scolytidae recorded from Australia with extensive additional data from Queensland. This includes 92 species in 35 genera.

Queensland with 72 species has many more than the other States.

Sixty-six species are considered to be endemic to Australia and 52 to Queensland.

Locality and host records show that many of the species are widely distributed and are associated with a variety of plants.

INTRODUCTION.

The post-war demand for timber gave impetus to the importation of logs from the rainforests of the islands to the north of Australia. Many of the shipments included logs showing active borer infestations on arrival at Brisbane and other Australian ports. Because Queensland has extensive rainforests, quarantine authorities were alerted to the risk of introducing undesirable borer species.

Most of the borers associated with the imported logs were Scolytidae and to assist quarantine the species already known to be present in Australia were listed and reviewed. The review was facilitated by extensive collections previously made by the author in Queensland and continued after the war.

The Scolytidae are borers, tunnelling as beetles or larvae, in most instances in the bark or wood of trees. Several of the species in Australia are of economic importance, but except those from Europe and America, rarely has any been responsible for direct attacks on growing trees.

On boring habits the Scolytidae may be divided into four general types—(*a*) the bark beetles, (*b*) the engraver bark beetles, (*c*) the wood-boring bark beetles, and (*d*) the wood borers. In all types the adults bore into the host tissues, where oviposition occurs. The bark beetles such as *Hylurdrectonus piniarius* Schedl confine their damage to the bark itself (Fig. 5). The engraver beetles like *Hylesinus varians* (Lea) tunnel in the cambial region, leaving an engraved scroll on both the inner bark and the sapwood (Figs. 2 and 3). In each of these two types the larvae make independent tunnels and feed on the host tissue. The wood-boring bark beetles (for example, *Pachycotes australis* Schedl) resemble the previous types in appearance but bore into the wood, where the larvae continue to tunnel and feed (Fig. 7). The wood borers, of which *Xyleborus* species are typical, penetrate directly into the wood and continue the tunnel system, which may extend deeply into the timber (Figs. 15 and 16). The larvae do not tunnel, and their food consists of fungal growths within the parent tunnels.

Generally four subfamilies are recognised in the Scolytidae. Two of these occur in Australia and the numbers of genera and species in each are as follows:—

Subfamily.	No. of Genera.	No. of Species.
Hylesininae	15	28
Ipinae	19	63
Unplaced	1	1
	35	92

The present list contains 75 named species and 17 still to be identified specifically or described as new. Sixty-six species are considered to be endemic to Australia, while the remainder, except a few from Europe and America, are common to Queensland, the adjacent islands, New Guinea and the East Indies. Of the Australian States, Queensland with 72 has the largest number of species. New South Wales, from published data, has 24, and only a few have been recorded in each of the other States. Fifty-two of the species occurring in Queensland are regarded as endemic.

In this presentation, genera are arranged alphabetically within subfamilies and species are similarly arranged in each genus. The more important synonyms are given. With each named species is included the reference to the type description, the type locality and, where available, the host of the type. Additional localities and hosts, unless otherwise stated, are from the author's records. Localities are not repeated unless for a different host and vice versa. Where an overseas type locality is given, "other records" relate only to Australia.

Subfamily HYLESININAE.*

This subfamily contains bark beetles, engraver bark beetles and wood-boring bark beetles. The bark beetles and their larvae show no regularity in tunnel pattern, but the engraver bark beetles and larvae make a specifically characteristic pattern. The tunnelling of the wood-boring bark beetles resembles the irregularly branched tunnels of some of the true wood-boring species.

I. Genus **ACACICIS** Lea, 1910: Proc. Roy. Soc. Viet. 22: p. 149.

This is an Australian genus, with two species confined to the southern States.

1. **abundans** Lea, 1910: Proc. Roy. Soc. Viet. 22: p. 149.

Type localities.—Tasmania (Aug. Simon. No. 2074): Hobart, Mt. Wellington, Bruni Is. etc.; Victoria: Emerald (A. M. Lea).

Other records.—Tasmania: Launceston; South Australia: Lucindale, Feuerheerdt (Schedl 1936).

2. **minor** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 525.

Type locality.—"New South Wales: Sydney and Wollongong (A. M. Lea)."

II. Genus **ARICERUS** Blandford, 1894: Ann. Soc. Ent. Belg. 38: p. 133.

Syn.—*Hylesinosoma* Lea, 1910: Proc. Roy. Soc. Viet. 22: p. 143.

Only one of the two species in this Australian genus is common. It occurs along the eastern coast and is confined essentially to figs as host trees.

3. **chapuisi** Blandford, 1894: Ann. Soc. Ent. Belg. 38: p. 134.

Type locality.—Australia.

Other record.—New South Wales: Tweed River (Schedl 1936).

4. **eichhoffi** Blandford, 1894: Ann. Soc. Ent. Belg. 38: p. 135.

Syns.—*Hylesinus fici* Lea, 1904: Proc. Linn. Soc. N.S.W. 29: p. 103.
Hylesinosoma fici Lea, 1910: Proc. Roy. Soc. Viet. 22: p. 143.

Type locality.—Australia: New South Wales.

Other records.—New South Wales: in wild fig (Froggatt 1899), Gosford (Schedl 1936); Queensland: Cairns district (A. M. Lea); Maryborough (E. W. Fischer); Mt. Tambourine (A. M. Lea) (Schedl 1936); *Ficus carica* L., Brisbane, Nov. 1910 (H. Tryon), also Gympie, Oct. 1934, Sunnybank, Nov. 1951; *Ficus macrophylla* Desf., Beenleigh, Nov. 1933; *Ficus rubiginosa* Desf., Brisbane, Nov. 1935; *Ficus* sp. National Park, Dec. 1919 (H. Hacker), also Emu Vale, Mar. 1941, Manumbar, Oct. 1942; a species of rainforest tree, Imbil, July 1937.

---

* See also Addendum.

This insect is common in rainforest and other places where native figs grow. The adults tunnel into the bark of suppressed or dying branches or of dying or felled trees. The larvae tunnel mainly in the phloem. Pupation occurs away from the parent entrance hole and therefore emerging beetles make new holes (Fig. 1). Froggatt (1899) gave brief notes on this insect

Fig. 1.

Aricerus eichhoffi. Bark of *Ficus* sp., showing emergence holes. (Slightly enlarged.)

under a mistaken identification of *Hylesinus porcatus* Chap., when it was recorded tunnelling as adults and larvae in the centre of terminal branches of a wild fig. Attacks in commercial fig orchards have been confined to the bark of dying branches.

III. Genus **DIAMERUS** Erichson, 1836: Arch. Naturgesch. 2 (1): p. 57.

Species of this genus occur in several tropical countries.

5. **curvifer** (Walker), 1859: Ann. Mag. Nat. Hist. 3: p. 261.

Syn.—*Hylesinus curvifer* Walker, 1859.

Type locality.—Ceylon.

Other record.—Queensland: Cairns, Apr. 1947 (J. G. Brooks).

6. **interstitialis** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 145.

Syn.—*Hylesinus interstitialis* Lea, 1910.

Type locality.—Queensland: Cairns (Macleay Museum, H. Hacker, E. Allen).

This species has been recorded from New Guinea.

IV. Genus **HYLASTES** Erichson, 1836: Arch. Naturgesch. 2 (1): p. 47.

Several species of this genus occurring in Europe and America attack only conifers and generally are considered to be of minor importance. Attacks are normally confined to dying trees or logs.

7. **ater** (Paykull), 1800: Fauna Suec. Ins. 3: p. 153.

Syn.—*Bostrichus ater* Paykull, 1800.

Type locality.—Sweden.

Other records.—South Australia: Mt. Burr, *Pinus radiata* D. Don (Swan 1942); New South Wales: species of *Pinus* (Hadlington 1951).

Swan (1942) recorded this insect as damaging young plantation *Pinus radiata* trees following a population pressure from breeding in nearby recently felled areas.

7A. **Hylastes** sp.

Queensland: *Araucaria cunninghamii* D. Don, Elgin Vale, Feb. 1944.

V. Genus **HYLEOPS** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 35.

This genus contains one species.

8. **glabratus** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 36.

Type locality and host.—"Nanango, Queensland, 14 September 1936, bred from hoop pine, A. R. Brimblecombe."

Other records.—Queensland: Nanango, July 1936; Imbil, Aug. 1936; and Emu Vale, Feb. 1939. On all occasions the host was *Araucaria cunninghamii.*

Fig. 2.

Hyleops glabratus. Adult and larval tunnelling on sapwood surface of *Araucaria cunninghamii.* (Half natural size.)

The adult beetle penetrates the bark to the cambial region, where mostly one but sometimes two egg galleries are made across the grain. Eggs are deposited in niches on both sides of the galleries. Larvae tunnel for a short distance at right angles to the parent tunnel and when full-grown again turn at right angles to make pupal chambers in the wood (Fig. 2). As determined by the number of pupal cavities accompanying galleries, up to 50 eggs may be laid by a female.

VI. Genus **HYLESINUS** Fabricius, 1801: Syst. Eleuth 2: p. 390.

Syn.—*Ficicis* Lea, 1910: Proc. Roy. Soc. Vict. 22: p. 147.

This is a well-known genus with species in most countries. Beetles attack freshly felled logs and dying trees or branches. Only one of the three Australian species is well known.

Fig. 3.

Hylesinus varians. Sapwood and inner bark of *Ficus stenocarpa* showing engraving by beetles and larvae. (Natural size.)

Fig. 4.

Hylesinus varians. Sapwood surface of *Pseudomorus brunoniana,* illustrating intensity of breeding. (Half natural size.)

9. **cordipennis** Lea, 1910: Proc. Roy Soc. Vict. 22: p. 144.

Type locality.—Queensland: Cairns (J. A. Anderson).

10. **koebelei** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 148

Syn.—*Ficicis koebelei* Lea, 1910.

Type locality.—Queensland (H. Hacker), also Barron Falls (A. Koebele).

Schedl (1936) suspected that this species, which is recorded also from New Guinea, might be a synonym of *H. philippinensis* Eggers.

11. **varians** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 147.

Syn.—*Ficicis varians* Lea, 1910.

Type localities and host.—New South Wales: Gosford (from dying trunks of cultivated fig, W. B. Gurney), Sydney (A. M. Lea).

Other records.—Queensland: Cairns district (Schedl 1936); *Pseudomorus brunoniana* (Endl.) Bur., Gympie, 1917 (H. Tryon), also Imbil, June 1941, Yarraman, Aug. 1945; *Morus alba* L., Brisbane, 1935; *Ficus stenocarpa* F. Muell. ex Benth., Imbil, June 1936; *Melicope neurococca* (F. Muell.) Benth., Gallangowan, Oct. 1939; *Ficus* sp., Emu Vale, Feb. 1939; a species of liana, Wongabel, Feb. 1935 (J. H. Smith); National Park, Nov. 1920 (H. Hacker).

This is one of the commonest bark beetles in Queensland rainforests. The parent beetles first bore a small mating chamber into the inner phloem, and then in each transverse direction excavate tunnels in which the eggs are placed singly in small side niches. The larvae tunnel parallel to the grain, engraving both the sapwood and inner bark (Figs. 3 and 4). Pupation occurs in cells at the ends of the tunnels and the new beetles eat their way directly through the bark to the exterior. Attacks occur only on dying or felled trees and on occasions may be so intense (Fig. 4) that it is doubtful if many of the progeny survive.

11A. **Hylesinus** sp.

Queensland: *Malasia scandens* (Lour.) Planch., Yarraman, June 1948.

VII. Genus **HYLURDRECTONUS** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 40.

12. **piniarius** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 40.

Type locality and host.—Queensland: "A. R. Brimblecombe, Yarraman Feb. 1934, from axes of hoop pine cones."

This is the only species in the genus. Since the first collection in May 1933 from hoop pine (*Araucaria cunninghamii*) at Yarraman, it has been found regularly in all rainforests where hoop pine occurs, and is one of the most abundant insects in hoop pine plantations in the same localities (vide Brimblecombe 1945). Also, it was found breeding in bunya pine (*Araucaria bidwillii* Hook.) at Cinnabar, Oct. 1942.

Fig. 5.

Hylurdrectonus piniarius. Bark of *Araucaria cunninghamii*, showing beetle entrance holes (arrow) and irregular larval tunnels. (Slightly less than natural size.)

Fig. 6.

Hylurdrectonus piniarius. Emergence holes through bark of *Araucaria cunninghamii.* (Natural size.)

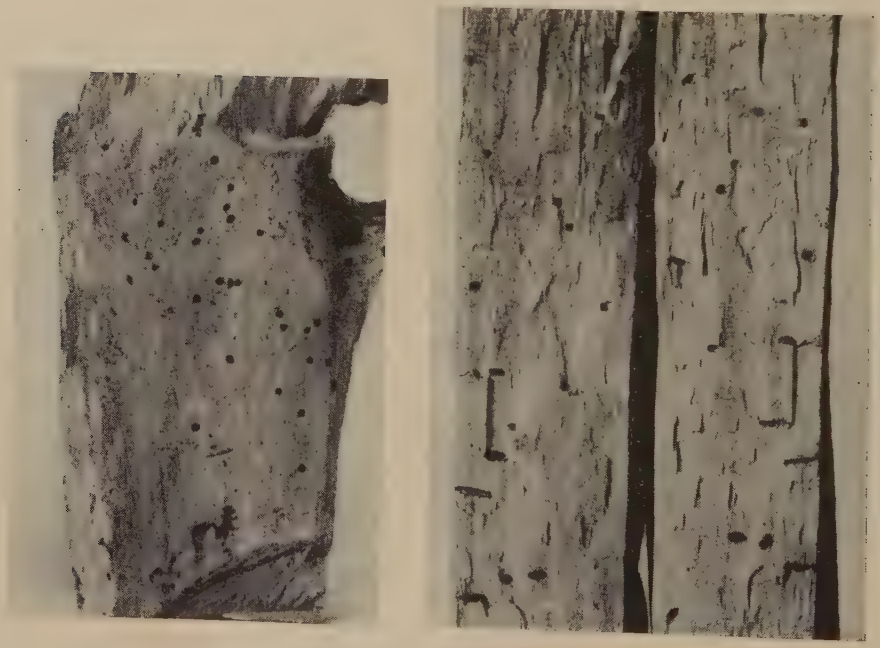

Fig. 7.

Pachycotes australis. A, Sapwood surface of *Araucaria cunninghamii,* showing entrance holes. (Three-quarters natural size.) B, Longitudinal section of *Araucaria cunninghamii,* showing tunnels. (Slightly more than half natural size.)

On fine warm days, adults emerge in large numbers from the parent host and take to the wing. They are strongly attracted to freshly felled or dying trees, pruned branches and pruning cuts on plantation trees. Branches dying from suppression also exert a strong attraction and this source of breeding material maintains a high population in plantations. Mating occurs while the insects are free-living. The beetles then bore into the cortex, without making a definite tunnel pattern, and there deposit eggs indiscriminately amongst the frass. The larvae likewises do not bore according to a definite pattern (Fig. 5). Tunnelling is almost entirely confined to the cortex, and even in young trees or branches rarely penetrates the stone layer. Pupation occurs in small cells at the ends of the larval tunnels and emerging beetles bore directly through the bark (Fig. 6). In summer the life cycle period is approximately five weeks, but during the cold weather this may be extended to six months. Adults are present throughout the year but are more abundant in summer and autumn.

VIII. Genus **HYLURGUS** Latreille, 1807: Gen. Crust. Ins. 2: p. 274.

This genus is predominantly European and the one species present in Australia is an introduction.

13. **ligniperda** (Fabricius), 1792: Ent. Syst. 1 (1): p. 367.

Syn.—*Bostrichus ligniperda* Fabricius, 1792.

Type locality.—Germany.

Swan (1942) recorded this bark beetle from South Australian plantations of *Pinus radiata* in association with *Hylastes ater.*

IX. Genus **LEPERISINUS** Reitter, 1913: Wien. Ent. Ztg. 32, Beih.: p. 41.

Species of this genus occur in several countries.

14. **bimaculatus** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 520.

Type locality.—Queensland: Blackall Range (A. M. Lea).

15. **tricolor** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 34.

Type locality.—Australia.

Other records.—New South Wales: *Baloghia lucida* Endl. (Hadlington 1951); Queensland: species of rainforest tree, Emu Vale, Feb. 1939.

16. **Leperisinus** sp.

Queensland: National Park, Aug. 1932 (H. Hacker).

X. Genus **PACHYCOTES** Sharp, 1877: Ent. Mon.Mag. 13: p. 266.

One species of this genus occurs in New Zealand and two in Australia.

17. **australis** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 38.

Type locality and host.—"New South Wales: Dorrigo; Queensland: Gallangowan, ex hoop pine log, A. R. Brimblecombe, 18th Jan. 1936."

Other records.—Benarkin, May 1936; Imbil, Jan. 1938; Yarraman, Oct. 1939. In all instances the host was *Araucaria cunninghamii.*

Froggatt (1927, pp. 92-93) gave a brief account and illustration of an insect from hoop pine, Dorrigo, under the name *Hylastes* sp. which is undoubtedly *Pachycotes australis.* It is probable that the type specimen from Dorrigo was part of Froggatt's material.

Beetles are attracted to felled hoop pine logs, and displaying a habit of the Ipinae penetrate into the wood (Fig. 7), where the larvae can make an extensive tunnel system. Damage may become serious if logs remain in the forest for several months, especially in moist weather during the summer. Entrance into the logs of plantation thinnings is through either the bark or exposed wood. The tunnel extensions made by the larvae penetrate deeply across the grain with little change in direction or plane. Branch tunnels change in both direction and plane and end in pupal cavities from which the new adults bore directly to the surface.

18. **clavatus** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 39.

Type locality.—New South Wales: Sydney.

XI. Genus **PHLOEOPHTHORUS** Wollaston, 1854: Ins. Maderensia: p. 209.

Species of this genus occur in North and South America.

19. **acaciae** Lea, 1910: Proc. Roy. Soc. Vict. 22: p. 146.

Type locality.—Tasmania.

XII. Genus **PHLOEOSINUS** Chapuis, 1873 (preprint 1869): Mem. Soc. Sci. Liege 3: p. 245.

Most species in this genus occur in North America, but a few are known from tropical countries. The beetles penetrate to the cambium, where egg galleries are made parallel to the grain. Larval tunnels are across the grain but those near the extremes of the egg gallery curve to the direction of the grain. Pupation occurs at the extremities of the tunnels and adults emerge directly to the exterior.

20. **australis** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 36.

Type locality.—Australia.

(*Note.*—The generic spelling used for this species was given as *Phloesinus* in error).

21. **cupressi** Hopkins, 1903: Bull. U.S. Bur. For. No. 38: p. 35.

Type locality.—California.

This species was first collected in Australia by K. L. Taylor in 1947 from *Cupressus torulosa* D. Don in Sydney. Hadlington (1951) recorded it as far as Hornsby and pointed out that in addition to killing *C. torulosa* trees it had attacked seedling *Callitris*. In California it is known to kill ornamental as well as forest cypress pine.

22. **transversarius** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 522.

Type locality.—Queensland: Blackall Range (A. M. Lea).

23. **?Phloeosinus sp.**

Queensland: Emu Vale, Feb. 1939.

XIII. Genus **PHLOEOTRIBUS** Latreille, 1796: Prec. Caract. Gen. Ins.: p. 50.

Species of this genus occur in America.

24. **australis** Schedl, 1953; Mem. Qld. Mus. 13: p. 80.

Type locality.—Queensland, Australia.

XIV. Genus **XYLECHINUS** Chapuis, 1873 (preprint 1869): Mem. Soc. Sci. Liege 3: p. 244.

Species of this genus are known from several east-Asian countries.

25. **leai** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 524.

Type locality.—Queensland: Cairns district (A. M. Lea).

Subfamily IPINAE.*

This subfamily contains bark beetles, engraver bark beetles and wood borers. The species of economic importance belong to the wood borers, which, because of their larval feeding habits, are known in some countries as ambrosia beetles. In Australia they are called pinhole or shothole borers, according to the size of the tunnels. The beetles bore through bark or exposed sapwood, and the extensive tunnel system can cause serious timber degrade in humid weather if logs are not quickly removed from foci of infestation in the forests. In addition to direct damage caused by the beetles, the ambrosial fungus often causes a blue stain extending deeply into the surrounding timber.

* See also Addendum.

XV. Genus **CARPOSINUS** Hopkins, 1915: Rep. Off. Secy. U.S. Dept. Agric. 99: p. 47.

Syn.—*Pelicerus* Eggers, 1923: Zool. Meded. 7: p. 216.

This genus is known from several Pacific countries.

26. **pini** var. **orientalis** Eggers, 1923: Zool. Meded. 7: p. 217.

Syn.—*Pelicerus nitidis* var. *orientalis* Eggers, 1923.

Type locality.—New Guinea (Salvatti).

Other record.—Queensland: Cairns district (Schedl 1936).

XVI. Genus **COCCOTRYPES** Eichhoff, 1878: Mem. Soc. Sci. Liege 8: p. 308.

This genus is known from several tropical countries.

27. **carpophagus** (Hornung), 1842: Ent. Ztg., Stettin 3: p. 116.

Syn.—*Bostrichus carpophagus* Hornung, 1842.

Type locality.—East Indies.

Other records.—Queensland: Seeds of a species of palm, Buderim, May 1911 (H. Tryon); palm seeds, Cairns, May 1930.

In Queensland, beetles have been found boring into palm seeds nearing maturity. The tunnels extend through the pulp into the hard seed, in which the eggs are deposited and where the larvae feed and pupate.

28. **dactyliperda** (Fabricius), 1801: Syst. Eleuth 2: p. 387.

Syn.—*Bostrichus dactyliperda* Fabricius, 1801.

Type locality and host.—Germany "in Dactylorum nucleis" (? *Phoenix dactylifera* L.).

Other records.—Queensland: date seeds, Nambour, 1921 (H. Tryon), also Gatton, Oct. 1937; *Phoenix canariensis* Chabaud, Sandgate, Dec. 1943; New South Wales: Sydney, Apr. 1921 (W. W. Froggatt) (Schedl 1936).

This is a cosmopolitan species and like *carpophagus* attacks the seeds of palm trees. Overseas it is known to attack the ivory nut (*Phytolephas macrocarpa* Ruiz & Pavon) and on a number of occasions it has been found damaging imported buttons made from this nut, sometimes after they had been used on manufactured goods (Fig. 8). Apparently small larvae were present when the buttons were made and in many instances subsequent tunnelling has resulted in almost complete destruction.

29. **Coccotrypes** sp.

Queensland: *Macadamia whelani* (F. M. Bail.) F. M. Bail., Babinda, Jan. 1939.

XVII. Genus **CRYPHALUS** Erichson, 1836: Arch. Naturgesch 2 (1): p. 61.

This genus is represented in many countries. The egg galleries made by the beetles are irregular tunnels in the bark. Larvae tunnel in the bark, barely touching on the sapwood.

Fig. 8.

Coccotrypes dactyliperda. Damaged ivory nut buttons. (One and a-half times natural size.)

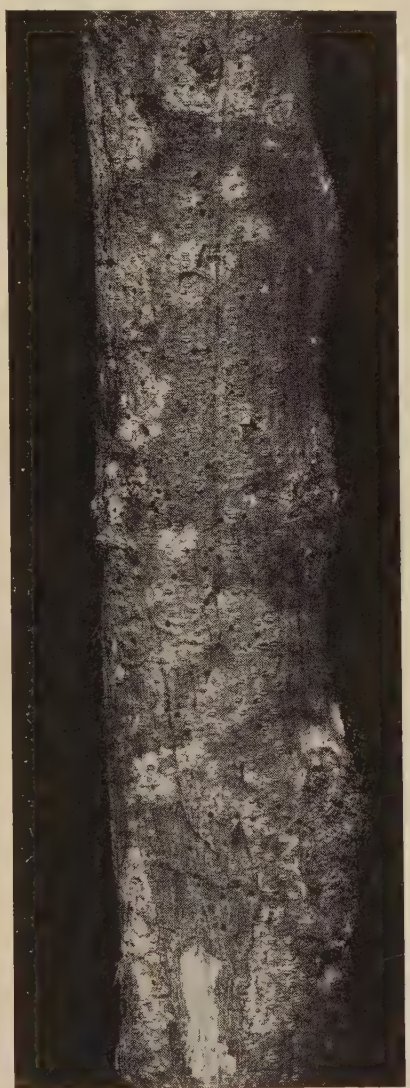

Fig. 9.

Cryphalus subcompactus. Emergence holes on the bark of *Grevillea robusta.* (Natural size.)

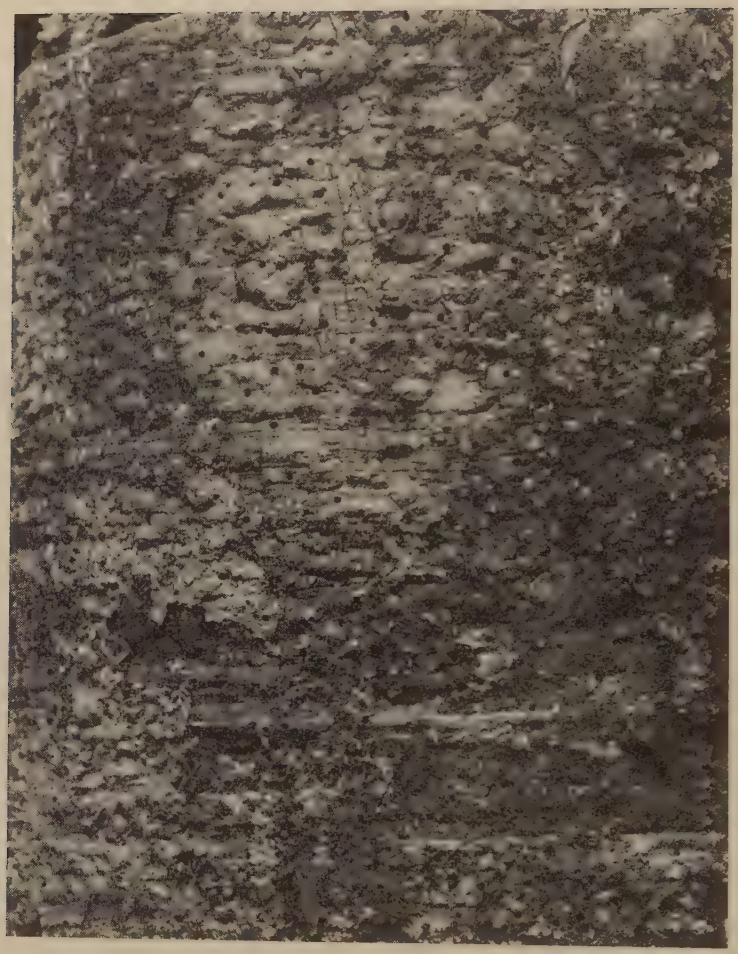

Fig. 10.

Cryphalus wapleri. Emergence holes in the bark of *Ficus* sp. (Slightly enlarged.)

30. **asperulus** Schedl, 1950 (preprint 1949): Proc. Roy. Soc. Qld. 1948 60: p. 26.

Type locality and host.—"Queensland: Imbil, 12.xii.1938, ex *Grevillea robusta,* A. R. Brimblecombe."

The habits of this species are similar to those decribed for *C. subcompactus* Lea, with which it was confused when the material was collected.

31. **brimblecombei** Schedl, 1950 (preprint 1949): Proc. Roy. Soc. Qld. 1948 60: p. 26.

Type locality and host.—"Queensland: Emu Vale, 8.iii.1941, *Cryptocarya erythroxylon*, A. R. Brimblecombe."

Adults bore into the bark and penetrate to the phloem or cambium, where eggs are laid amongst loose frass in short, irregular egg galleries. Because of the comparatively thick phloem, larval tunnels do not extend far from the egg galleries and may not follow the grain.

32. **compactus** Lea, 1910: Proc. Roy. Soc. Vict. 22: p. 139.

Type locality.—Queensland: Port Denison.

33. **pilosellus** Erichson, 1842: Arch. Naturgesch 8 (1): p. 212.

Type locality.—Van Diemen's Land.

Other records.—Tasmania: from *Bursaria spinosa* (Lea 1910), Hobart, Launceston (Schedl 1936); South Australia: Mt. Lofty Range, Lucindale, Feuerheerdt (Schedl 1936).

34. **sidneyanus** (Nordlinger), 1856: Nachtrage, Ratzerlrorg's Forstinsekten: p. 75.

Syn.—*Bostrichus sidneyanus* Nordlinger, 1856.

Type locality.—Australia.

35. **subcompactus** Lea, 1910: Proc. Roy. Soc. Vict. 22: p. 140.

Type localities.—New South Wales: Galston (D. Dumbrell), Sydney (A. M. Lea).

Other records.—Queensland: Imbil, Aug. 1936; Atherton, May 1941; Nanango, Nov. 1944. In all instances the host was *Grevillea robusta* A. Cunn. ex R. Br.

The beetles penetrate the bark of suppressed branches or freshly felled trees (Fig. 9). The eggs are laid amongst frass in a short irregular tunnel. Larval tunnels are mostly parallel to the grain and unless the bark is thin no engraving occurs on the sapwood.

36. **wapleri** Eichhoff, 1871: Berl. Ent. Z. 15: p. 131.

Type locality.—Australia.

Other records.—Queensland: National Park, Jan. 1929 (H. Hacker): *Ficus* sp., Emu Vale, Feb. 1941; *Malasia scandens*, Yarraman, June 1948.

Adults were attracted to recently felled trees of *Ficus* and brushed vines of *Malasia*. In the former, tunnelling was irregular in the bark with individual emergence holes (Fig. 10). In woody stems of *Malasia*, tunnelling was confined to the bark but extended into the xylem of young stems.

37. **Cryphalus** sp.
Queensland: *Grevillea robusta,* Imbil, Dec. 1939.

38. **Cryphalus** sp.
Queensland: *Malasia scandens,* Yarraman, June 1948.

XVIII. Genus **DRYOCOETES** Eichhoff, 1864: Berl. Ent. Z. 8: p. 38.

This genus is known from several countries. The beetles bore into the phloem, first making an irregular cavity then several tunnels across the grain with lateral egg niches. Larvae tunnel parallel with the grain. Pupation occurs at the ends of the tunnels and the new beetles emerge directly to the exterior.

39. **dimorphus** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 527.
Type locality and host.—"New South Wales: Burwood, on *Pittosporum* sp., July 12, 1929."

XIX. Genus **ECCOPTOPTERUS** Motschoulsky, 1863: Bull. Soc. Imp. Nat. Moscou. 36: p. 515.
Species occur in tropical countries, mainly in the western Pacific.

40. **sexspinosus** (Motschoulsky), 1863: Bull. Soc. Imp. Nat. Moscou. 36: p. 515.
Syn.—*Xyleborus sexspinosus* Motschoulsky, 1863.
Type localities.—Mts. Nura-Ellia, Ceylon and Burma.
Other record.—Queensland: Coen R. (Schedl 1936).

This species occurs on various hosts in most tropical countries.

41. **Eccoptopterus** sp.
Queensland: Cairns, Nov. 1944.

XX. Genus **ERIOSCHIDIAS** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 42.

This genus was named to accommodate Lea's species *Cryphalus setistriatus,* and one other species has been added.

42. **queenslandi** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 43.
Type locality.—Queensland: Cairns district (A. M. Lea).

43. **setistriatus** (Lea), 1910: Proc. Roy. Soc. Viet. 22: p. 141.
Syn.—*Cryphalus setistriatus* Lea, 1910.
Type locality.—Western Australia: Rottnest Island (A. M. Lea).

XXI. Genus **HYPOCRYPHALUS** Hopkins, 1915: Rep. Off. Secy. U.S. Dept. Agric. 99: p. 41.

Species occur in America and on several Pacific islands.

44. **nigrosetosus** Schedl, 1950: (preprint 1949): Trans. Roy. Soc. Qld. 1948 60: p. 27.

Type locality and host.—"Queensland: Kalpowar, ? *Capparis nobilis*, 1.39, A. R. Brimblecombe."

Fig. 11.

Hypocryphalus nigrosetosus. Tunnelling showing on sapwood surface of (?) *Capparis nobilis.* (Half natural size.)

Adults penetrate to the cambial layer and appear to lay eggs in a "keyhole" cavity from which the larvae radiate in an irregular manner to pupate at tunnel extremities (Fig. 11).

45. **spathulatus** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 49.

Type locality.—Queensland: Cairns district (A. M. Lea).

XXII. Genus **HYPOTHENEMUS** Westwood, 1834: Trans. Ent. Soc. Lond. 1: p. 34.

Species of this genus occur in most tropical countries. They are rather small and make indefinite galleries in the phloem, often engraving the sapwood.

46. **erythrinae** (Eggers), 1936: Ann. Mag. Nat. Hist. 17: p. 628.

Syn.—*Stephanoderes erythrinae* Eggers, 1936.

Type locality and host.—Sakalaspur, India, 19.7.30 on *Erythrina.*

Other records.—Queensland: *Passiflora edulis* Sims, Redland Bay, Sept. 1939; *Delonix regia* (Boj.) Raf., Brisbane, Mar. 1946.

Beetles penetrated the woody tissue in *Passiflora* but in Poinciana they occurred in the thin bark of branches. In both instances the plants were dying from other causes.

47. **striatopunctatus** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 142.

Syn.—*Cryphalus striatopunctatus* Lea, 1910.

Type locality.—New South Wales: National Park, Sydney (A. M. Lea).

This species is also known from New Guinea.

48. **tantillus** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 142.

Syn.—*Cryphalus tantillus* Lea, 1910.

Type locality.—New South Wales: Richmond River (A. Coates).

Other records.—Queensland: *Antirrhinum* sp., Sandgate, Sept. 1932; *Carica papaya* L., Brisbane, Jan. 1934; *Cydonia oblonga* Mill., Brisbane, Aug. 1936; *Ficus hillii* F. M. Bail., Brisbane, June 1937; *Wistaria floribunda* (Willd.) DC., Brisbane, Feb. 1938; *Eucalyptus tereticornis* Sm., Brisbane, Feb. 1938; *Pinus* sp., Beerwah, May 1944; *Grevillea robusta,* Imbil, Apr. 1938.

Beetles of this insect have penetrated a wide variety of plant tissues—for example, *Antirrhinum* seed capsule, dried fruit of papaw and persimmon, the bark of woody trees and the woody tissue of *Wistaria.*

49. **Hypothenemus** sp.

Queensland: Brisbane, 1932.

50. **Hypothenemus** sp.

Queensland: Rainforest tree, Emu Vale, Mar. 1939

XXIII. Genus **IPS** De Geer, 1775: Mem. Hist. Ins. 5: pp. 190, 193.

Many species of this genus are present in America; a few occur in Europe and Malaya. The beetle normally makes two egg galleries, one in each direction along the grain from the point of entrance. The eggs are laid in niches along the galleries and the larvae on hatching tunnel at right angles to the parent tunnels, making a characteristic herringbone pattern. Breeding in thin bark is preferred and therefore young trees or branches are attacked. Normally only trees in reduced vigour or felled trees are chosen, but due to the pressure of populations following intensive breeding living trees may be attacked.

51. **grandicollis** (Eichhoff), 1867: Berl. Ent. Z. 11: p. 402.

Syn.—*Tomicus grandicollis* Eichhoff, 1867.

Type locality.—America borealis.

Other records.—South Australia: *Pinus nigra* Arnold, Mt. Burr; *P. halepensis* Miller; *P. radiata* (Swan 1950).

The insect is at present of limited distribution in South Australia, and although first found in that State in 1943, it was not until 1950 that serious damage was recorded (Swan 1950). According to that author it prefers to breed in freshly felled timber, particularly logging residues, and if other conditions also favour breeding, attacks can then be transferred to nearby living trees, more especially young trees. Extensive breeding in logging residues of *Pinus halepensis* in South Australia was responsible for attacks on adjacent plantations of young *Pinus radiata*. The importance of the insect is increased by the fact that it transmits a blue-staining fungus which can cause rapid deterioration of attacked timber.

XXIV. Genus **LETZNERELLA** Reitter, 1913: Wien. Ent. Ztg. 32 Beih.: p. 68.

Species occur in several tropical countries.

52. **tricolor** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 141.

Syn.—*Cryphalus tricolor* Lea, 1910.

Type locality.—Queensland: Cairns (E. Allen).

Fig. 12.

Letznerella tricolor. Pieces of *Millettia megasperma*, showing emergence holes and tunnelling. (Natural size.)

Other record.—Queensland: *Millettia megasperma* (F. Muell.) Benth., Imbil, Nov. 1936.

Beetles penetrate the bark of dying vines, and larvae tunnel in the cambial region, engraving the woody tissue (Fig. 12).

XXV. Genus **POECILIPS** Schaufuss, 1897: Berl. Ent. Z. 42: p. 110. Species occur in several tropical countries.

53. **cyperi** (Beeson), 1929: Insects of Samoa: Part 4; Fasc. 4: p. 230.

Syn.—*Thamnurgides cyperi* Beeson, 1929.

Type locality and host.—Upolu, Apia, on sedge.

Other records.—Queensland: *Macadamia whelani,* Babinda, 1939; Eubenangee, 1949 (J. G. Brooks).

This insect is recorded also from Java, Assam, Burma and Bengal. Since *Macadamia whelani* can grow to a large tree, it would seem that the record "on sedge" for the Samoan material may represent a chance collection rather than a host record.

XXVI. Genus **PROGENIUS** Blandford, 1896; Ann. Soc. Ent. France 65: p. 20.

Species are known in tropical countries extending from Indo-China to Australia.

54. **Progenius** sp.

Queensland: Brisbane, Jan. 1937.

XXVII. Genus **PTILOPODIUS** Hopkins, 1915: Rep. Off. Secy. U.S. Dep. Agric. 99: pp. 7, 11.

Species occur in America and some of the Pacific islands.

55. **Ptilopodius** sp.

Queensland: *Excoecaria dallachyana* (Bail.) Benth., Yarraman, May 1947.

Beetles penetrate the bark of felled trees and larvae tunnel in an irregular manner in the phloem (Fig. 13).

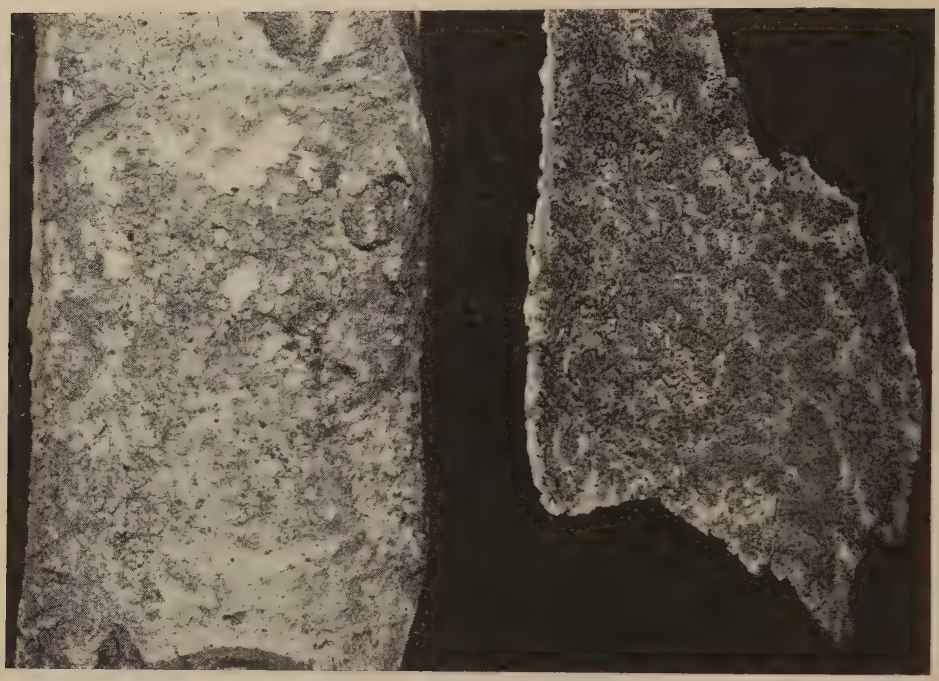

Fig. 13.

Ptilopodius sp. Emergence holes and tunnelling in the bark of *Excoecaria dallachyana*. (Natural size.)

XXVIII. Genus **SCOLYTOGENES** Eichhoff, 1878: Mem. Soc. Sci. Liege 8: p. 475: 1878, Ent. Ztg. Stettin 39: p. 387.

Species are known from several Pacific islands.

56. **major** (Eggers), 1927: Philipp. J. Sci. 33: p. 69.

Syn.—*Negritus major* Eggers, 1927.

Type locality.—Philippines: Mindanao, Basilan.

Other record.—Queensland: Cairns, Jan. 1949 (J. G. Brooks).

XXIX. Genus **SCOLYTOTARSUS** Schedl, 1937: Riv. Zool. Bot. Afr. 29: p. 404.

A species is known from tropical West Africa.

57. **maculatus** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 534.

Type locality.—Queensland: Coen district, Cape York (H. Hacker).

XXX. Genus **STEPHANODERES** Eichhoff, 1871: Berl. Ent. Z. 15: p. 132.

This genus is cosmopolitan and the beetles bore into dying or dead twigs. Tunnels are more often in the bark but they may penetrate the wood if it is soft. The larvae occur in the tunnels with the adults, but move to the extremities of the tunnels, which are sealed off for pupation.

58. **darwiniensis** Schedl, 1942: Mitt. Munch. Ent. Ges. 32: p. 178.

Type localities and host.—Australia: Darwin; N. Queensland: Cairns, Leichhardt tree, 17.3.34 (J. H. Smith).

Other records.—Queensland: *Ficus carica,* Brisbane, May 1949; *Saccharum officinarum* L., Brisbane, June 1949; *Citrus* sp., Brisbane, 1949.

Fig. 14.

Stephanoderes darwiniensis. Surface of wood of *Ficus carica,* showing tunnelling. (Natural size.)

Tunnelling in figs occurs only in dying or recently dead branches and is common on the dying ends of pruned twigs (Fig. 14). At first it is confined to the cambial region but later extends into the wood. The attack on sugar cane occurred in overmature sticks and penetrated in various directions in the internal tissue.

59. **maculicollis** (Sharp), 1879: Trans. Ent. Soc. London 1879: p. 101.

Syn.—*Hypothenemus maculicollis* Sharp, 1879.

Type locality.—Hawaii.

Other records.—Queensland: *Prunus domestica* L., Maryborough, Feb. 1932; *Eucalyptus trachyphloia* F. Muell., Redland Bay, Sept. 1937; *Litchi chinensis* Sonn., Bowen, Oct. 1946.

The beetles were found tunnelling in the inner layers of the bark.

60. **melasomus** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 140.

Syn.—*Cryphalus melasomus* Lea, 1910.

Type localities.—New South Wales: Clarence River (G. Compere), Wollongong (A. M. Lea).

Other records.—New South Wales: *Casuarina* sp., Sydney (Schedl 1936); Queensland: Brisbane (Schedl 1936); *Alphitonia excelsa* (Fenzl.) Benth., Mt. Coot-tha, Aug. 1937; *Delonix regia,* Brisbane, Aug. 1945; *Eucalyptus acmenioides* Schau., Brisbane, May 1947.

In all instances the attacks were in small dying twigs and adults had penetrated beyond the bark into the wood.

61. **Stephanoderes** sp.

Queensland: *Alphitonia excelsa,* Blair Athol, Oct. 1938.

62. **Stephanoderes** sp.

Queensland: *Litchi chinensis,* Bowen, Oct. 1946.

XXXI. Genus **THAMNURGIDES** Hopkins, 1915: Rep. Off. Secy. U.S. Dept. Agric. 99: p. 45.

Syn.—*Dendrugus* Eggers, 1923: Zool. Meded. 7: p. 144.

Species of this genus are known from India and several Pacific countries.

63. **philippinensis** Eggers, 1923: Zool. Meded. 7: p. 145.

Syn.—*Dendrugus philippinensis* Eggers, 1923.

Type localities.—Mt. Mikiling, Luzon Is., Philippines, and from New Guinea.

Other record.—Queensland: Cairns district (A. M. Lea) (Schedl 1936).

Eggers (1927) placed *Dendrugus* Eggers as a synonym of *Thamnurgides* Hopkins, but Schedl (1938) considered it to be a synonym of *Poecilips* Schaufuss, in which he placed some species of *Thamnurgides,* including *philippinensis.*

XXXII. Genus **XYLEBORUS** Eichhoff, 1864: Berl. Ent. Z. 8: p. 37.

Many species of this genus are known from practically every country and some of them, such as *X. perforans* (Wollaston), have a wide natural distribution while others have been spread by human agencies. The genus is by far the largest in the family, and it contains more than a quarter of the Australian Scolytids. The habitat of most species is the humid tropical rainforest, where climatic conditions maintain a high moisture content in the host tissues and favour the growth of the ambrosial fungi on which the *Xyleborus* species subsist.

During humid weather, beetles are stimulated to leave old host tissue and are strongly attracted in most instances to felled, suppressed or dying trees, into which they bore either through the bark or directly into exposed wood. Some species make an extensive branched tunnel system penetrating deeply into the host tissue. Eggs are laid in the tunnels and larvae may move throughout the system. Other species make "keyhole" cavities a short distance from the surface, and eggs, larvae, pupae and beetles may be found congregated together.

Many of the economic species become of importance only after some other agency has made the host tissue attractive, such as with freshly felled logs, and in these the extent of the infestation and damage depends on the time intervals between felling, removal from the forest and conversion. Some species directly attack living plants or trees, but this habit is not dominant in endemic Australian species.

64. **abruptulus** Schedl, 1953: Mem. Qld. Mus. 13: p. 81.

Type locality and host.—"Queensland: Wongabel, ex *Loranthus* sp., 2.5.41, A. R. Brimblecombe."

Adults were found tunnelling into the woody stems of a dying mistletoe plant which had previously been dislodged from its host tree.

65. **acanthurus** (Lea), 1910: Proc. Roy. Soc. Vict. 22: p. 137.

Syn.—*Tomicus acanthurus* Lea, 1910.

Type locality.—Queensland: Cairns.

66. **affinis** Eichhoff, 1867: Berl. Ent. Z. 11: p. 401.

Type locality.—America borealis, Cuba.

This species is recorded from most tropical countries. The beetles make a complicated tunnel system consisting of short entrance holes and extended longitudinal tunnels with many transverse branches. Blue-staining fungi are transmitted by the beetles from infected old hosts to new hosts. Beeson (1929) recorded it from Australian regions.

67. **artestriatus** Eichhoff, 1878: Mem. Soc. Sci. Liege 8: p. 507.

Type locality.—East Indies.

Other record.—Northern Territory: Darwin (F. G. Hill) (Schedl 1936).

68. **compressus** (Lea), 1894: Proc. Linn. Soc. N.S.W. 8: p. 321.

Syn.—*Xylopertha compressa* Lea, 1894.

Type localities.—Tamworth and Sydney.

Other records.—New South Wales: Tamworth, Galston (Dumbrell), Dorrigo (W. Heron), St. Marys, Upper William R. (Lea and Wilson, October 1926, ex Pittosporum) and Burwood 19.7.29 (Schedl 1936); Sth. Australia: Mt. Lofty Ra. (S. H. Curnow), Lucindale, Feuerheerdt and Adelaide (A. M. Lea) (Schedl 1936); Tasmania: Hobart (A. M. Lea) and Kelso (A. Simson) (Schedl 1936); Queensland: Blackall Ra. (A. M. Lea), Mount Tambourine, Brisbane, Bowen (Schedl 1936); Bunya Mts., Dec. 1925, (H. Hacker); *Araucaria bidwillii,* Yarraman, Apr. 1933; *Araucaria cunninghamii,* Brisbane, Feb. 1935, also Imbil, Mar. 1935, Emu Vale, Feb. 1941, Tambourine Mt., Mar. 1945; *Endiandra palmerstonii* (F. M. Bail) Wh. & Fr., also *Flindersia brayleyana* F. Muell., *Flindersia bourjotiana* F. Muell., *Argyrodendron trifoliatum* F. Muell. var. *peralatum* (F. M. Bail.) Burtt-Davy, Gadgarra, Apr. 1934 (J. H. Smith); *Eucalyptus tereticornis,* Goodna, July 1936; *Castanospermum australe* A. Cunn. & Fraser ex Hook., Wongabel, July 1937; *Eucalyptus maculata* Hook., also *Eucalyptus seeana* Maiden, Goodna, Mar. 1938.

This insect is not normally common in Queensland although its distribution extends from the Atherton Tableland in the north to the border in the south. On two occasions beetles were found in numbers on the wing just before dusk, but in most instances they were taken only as individuals from freshly felled logs, where entrance occurred on exposed wood. Beetles may also be attracted to and tunnel into freshly sawn or rain-drenched timber in mill yards.

69. **confusus** Eichhoff, 1867: Berl. Ent. Z. 11: p. 401.

Type localities.—Chile, Venezuela.

Beeson (1929) recorded this insect from Queensland. It is known from rainforests of most tropical islands.

70. **eucalypticus** Schedl, 1938: Trans. Roy. Soc. S. Aust. 62: p. 51.

Type locality and host.—"North Queensland: Geagana, June 15, 1934, ex *E. palmerstoni* T. H. Smith."

(*Note:* The locality is Gadgarra, the host *Endiandra palmerstonii* and the collector J. H. Smith.)

The spelling of the name given as the species heading (*eucalyticus*) by Schedl does not agree with that used in the legend of the illustration (*eucalypticus*). It would appear that Schedl thought the host *E. palmerstonii* was a eucalypt in naming the species *eucalypticus*.

Other records.—Queensland: *Nauclea orientalis* L., Wongabel, Mar. 1934 (J. H. Smith); *Endiandra palmerstonii*, Gadgarra, May 1934, also Wongabel, Dec. 1934 (J. H. Smith); *Flindersia brayleyana*, Gadgarra, June 1934 (J. H. Smith); *Cardwellia sublimis* F. Muell., Gadgarra, June 1934 (J. H. Smith); *Araucaria cunninghamii*, Emu Vale, June 1937; *Euroschinus falcatus* Hook. f., Imbil, July 1938.

The beetles penetrate the bark of some hosts, or enter the wood directly and tunnel in various directions, sometimes extending well into the logs (Brimblecombe 1951).

71. **funereus** Lea, 1910: Proc. Roy. Soc. Vict. 22: p. 139.

Type locality.—Queensland: Cairns (E. Allen).

72. **indicus** Eichchoff, 1878: Mem. Soc. Sci. Liege 8: p. 354.

Type locality.—Java.

Other record.—Queensland: Mulgrave River (H. Hacker) (Schedl 1936).

This species has a distribution through the East Indies, Malaya and Ceylon to East Africa.

73. **insulindicus** Eggers, 1923: Zool. Meded. 7: p. 177.

Type localities.—S.E. New Guinea, Paumomu River, Kuranda (Australia).

Other records.—Queensland: *Flindersia acuminata* C. T. White, Gadgarra, Apr. 1932 (J. H. Smith); *Endiandra palmerstonii*, Gadgarra, Feb. 1933 (J. H. Smith); *Cardwellia sublimis*, Clump Pt., Aug. 1934.

74. **latecompressus** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 532.

Type localities.—New South Wales: Upper Williams R. (Lea and Wilson, October, 1926), Galston (Dumbrel); Victoria: Kewell (Hill 1877).

75. **morigerus** Blandford, 1894: Insect Life 6: p. 264.

Syn.—*X. coffeae* Wurth, 1908: Meded v. h. Allgem. Proefst. of Java 2: pp. 63-8.

Type locality.—New Guinea.

Other records.—Queensland: *Dendrobium phalaenopsis* Fitzg., Cleveland, Nov. 1937, and Brisbane, Oct. 1948.

Attacks on orchids also occur in North Queensland, but particular records are not available. The insect is known from most tropical countries.

The beetle bores into the orchid stems, penetrating to the soft internal tissue, where it makes a "keyhole" cavity, sometimes to three-quarters of an inch in length. Eggs are deposited in this cavity and later adults, eggs, larvae and pupae may be present concurrently. Attacks are made on living plants, and on old stems as many as 12-15 entrance holes may occur in a stem length of 10 inches. The associated fungus causes a blue-staining and appears to assist in the death of attacked stems. The insect is troublesome to commercial orchid growers.

76. **parvus** (Lea), 1894: Proc. Linn. Soc. N.S.W. 8: p. 321.

Syn.—*Xylopertha parva* Lea, 1894.

Type locality.—Richmond River.

77. **perforans** (Wollaston), 1857: Catal. Col. Ins. Madeira: p. 96.

Syns.—*Tomicus perforans* Wollaston, 1857.
Bostrichus testaceus Walker, 1859: Ann. Mag. Nat. Hist. 3: p. 260.
Xyleborus testaceus (Walker), 1859.
Xyleborus kraatzi Eichhoff, 1868: Berl. Ent. Z. 12: p. 152.
Xyleborus immaturus Blackburn, 1885: Trans. Roy. Soc. Dublin 3: p. 193.
Xylopertha hirsuta Lea. 1894: Proc. Linn. Soc. N.S.W. 8: p. 317.
Xyleborus hirsutus (Lea), 1894.

Type locality.—Madeira, attacking bungs of wine casks. The type localities of *Xylopertha hirsuta* were Tamworth, Cootamundra, Tweed and Richmond River, N.S.W.

Other records.—Queensland: Cairns, Jan. 1891; *Litsea* sp., Gadgarra, Oct. 1930 (J. H. Smith); *Endiandra palmerstonii,* Gadgarra, Mar. 1931 (J. H. Smith); *Cedrela toona* Roxb. var. *australis* (F. Muell.) C. D.C., also *Elaeocarpus grandis* F. Muell., *Xanthostemon pubescens* C. T. White, *Flindersia bourjotiana,* Gadgarra, Feb. 1932 (J. H. Smith); *Araucaria cunninghamii,* Nambour, Aug. 1932, also Gympie, July 1933, Imbil, Mar. 1935, Emu Vale, Feb. 1939, Yarraman, Mar. 1948; *Annona squamosa* L., Koumala, Sept. 1933 (J. H. Smith), also Redland Bay, Feb. 1938; *Argyrodendron trifoliatum,* Yarraman, Feb. 1934; *Flindersia laevicarpa* Wh. & Fr., also *Flindersia bourjotiana* Danbulla, Mar. 1934 (J. H. Smith); *Flindersia brayleyana* also *Dysoxylum pettigrewianum* F. Muell., Gadgarra, Mar. 1934 (J. H. Smith); *Eucalyptus intermedia* R. T. Baker, El Arish, May 1934 (J. H. Smith); *Citrus sinensis* Osbeck, Cardwell, May 1934, also Gayndah, 1950 (A. A. Ross); *Melaleuca leucadendron* (L.) L., Cardwell, May 1935; *Argyrodendron trifoliatum* var. *peralatum,* Gadgarra, Aug. 1934 (J. H. Smith); *Castanospermum australe,* Wongabel, Dec. 1934 (J. H. Smith); *Mangifera indica* L., Dayboro, Mar. 1935; *Casuarina cunninghamiana* Miq., Canungra,

Mar. 1937; *Cinnamomum camphora* (L.) Neds & Eberm., Brisbane, Feb. 1938; *Eucalyptus intermedia*, also *E. maculata*, *E. drepanophylla* F. Muell. ex Benth., *E. seeana*, *E. tereticornis*, *Angophora costata* (Gaertn.) Domin, R. 446 Stapylton, Mar. 1938; *Cinnamomum baileyanum* (F. Muell. ex F. M. Bail.) W. D. Francis, Fraser Is., Mar. 1938; *Carica papaya*, Goomboorian, Apr. 1938; *Baloghia lucida*, Imbil, June 1938; *Eucalyptus maculata*, Barakula, July 1938; *Eucalyptus citriodora* Hook., R. 8 Doongul, Sept. 1938; *Cardwellia sublimis*, Gadgarra, Oct. 1938; *Eucalyptus drepanophylla*, Blair Athol, Oct. 1938; *Dysoxylum muellerii* Benth., Emu Vale, Feb. 1941; *Agathis palmerstonii* F. Muell., Cairns, Apr. 1941; *Argyrodendron*

Fig. 15.

Xyleborus perforans. Longitudinal section of *Euroschinus falcatus*, showing tunnels. (Four-fifths natural size.)

trifoliatum var. *peralatum*, also *Cedrela toona* var. *australis*, *Aleurites moluccana* (L.) Willd., Wongabel, Apr. 1941; *Planchonella pohlmaniana* (F. Muell.) Pierre ex Dubard., Yarraman, May 1942; *Ficus stenocarpa*, Gallangowan, Oct. 1942; *Euroschinus falcatus*, Yarraman, Aug. 1947, also Imbil, May 1950; *Delonix regia*, Cleveland, Mar. 1948; timber of alcohol vat, Sarina, 1944; beer casks, Brisbane, 1937; *Eucalyptus grandis* W. Hill ex Maiden, Gallangowan, Feb. 1944; *Jacksonia* sp., Fletcher, Feb. 1948.

Fig. 16.

Xyleborus perforans. Transverse section of *Araucaria cunninghamii* thinning, showing tunnel system. (Natural size.)

Accounts of this insect occur in many publications and Froggatt (1925, 1926) discussed it under both the names *X. perforans* and *X. hirsutus*. The insect is particularly widespread in Australia, occurring in a wide variety of hosts in both open forest and rainforest (Brimblecombe 1951). Tunnels are made only by females. They are simple or branched, extending

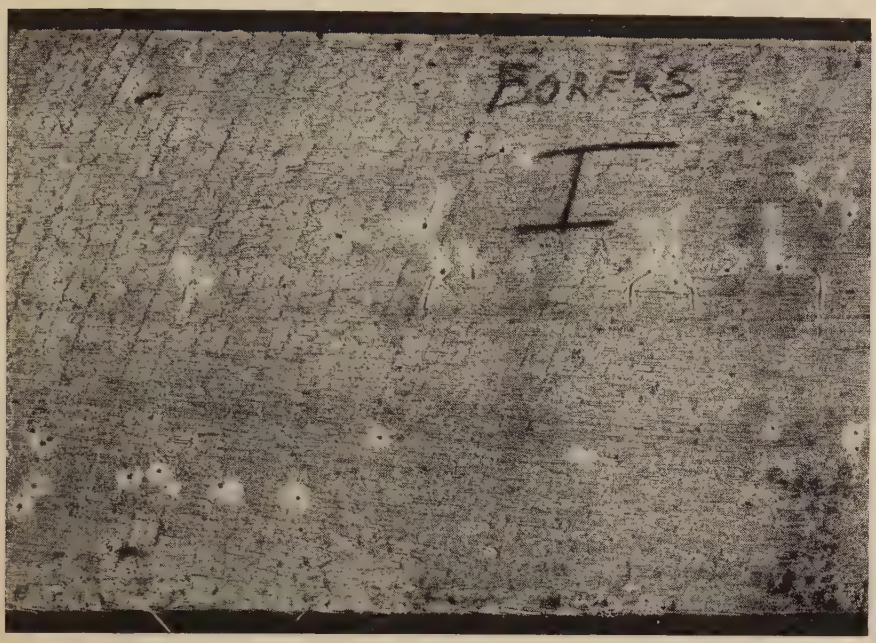

Fig. 17.

Xyleborus perforans. A board from a wet stack attacked by beetles. (Half natural size.)

deeply into the wood of the host tree or log (Figs. 15-17). Eggs are laid in the tunnels, and the larvae may move throughout the system. The males are flightless, mating occurring in the parent host tissue before the females are stimulated to leave in search of new host tissue. Attacks may also occur on freshly sown or rain-wet timber (Fig. 17) stacked in the millyard. The life cycle may be completed in three months during the summer.

78. **pityogenes** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 534.

Type locality.—Australia.

79. **pseudoangustatus** Schedl, 1950 (preprint 1949): Proc. Roy. Soc. Qld. 1948 60: p. 28.

Type localities and hosts.—"Queensland: Stapleton, 8.1936, ex *Eucalyptus maculata,* A. R. Brimblecombe; Stapleton 14.9.1936, ex *Eucalyptus maculata,* J. W. Gottstein; Brookfield, 3.1.1938, ex Loquat, A. R. Brimblecombe; Stanthorpe, 14.3.1946, ex Apple, J. H. Smith; Stanthorpe, 8.2.1946, ex Plum, J. H. Smith; New South Wales: West Pennant Hills, 2.10.1945, ex Apple, A. H. Friend."

Other records.—Queensland: *Prunus persica* (L.) Batsch., 1946, also *Prunus armeniaca* L., *Prunus avium* L., *Prunus persica* var. *nectarina* Maxim *Pyrus communis* L., Stanthorpe, 1946 (N. E. H. Caldwell).

Fig. 18.

Xyleborus pseudoangustatus. Longitudinal section of loquat, showing "keyhole" cavities. (Natural size.)

Caldwell (1946) studied the attacks of this insect on deciduous fruit trees in the Stanthorpe district. According to that author, adults bore into living trees which though not robust are amongst the best in the orchards concerned and average for the district. The points of entry are sometimes evident by a slight gum exudate. A small straight tunnel leads into a "keyhole" shaped brood chamber mostly parallel with the grain (Fig. 18). Eggs are deposited in the chamber and a fungus growing on the walls provides food for the larvae. Later all stages of the insect occur in the chamber at the one time. Foliage may wilt and branches or the whole tree may die. Pathogenic organisms found in association with these insects are suspected as the cause of the comparatively rapid collapse of some trees and the insect is considered to be the vector.

The attacks by this borer were serious in 1946, slight in 1947 and have since been negligible.

80. **pseudosolidus** Schedl, 1936: Rec. S. Aust. Mus. 5: p. 530.

Type localities.—Tasmania; New South Wales: Dorrigo and Narara (Hudson, October 16, 1896).

Other records.—Queensland: *Prunus domestica,* also *Malus sylvestris* Mill., Stanthorpe, Oct. 1929; *Prunus armeniaca,* Applethorpe, Nov. 1935, (H. Jarvis); *Mangifera indica,* Dayboro, Dec. 1935.

Most of the records of this insect in Queensland are from the deciduous orchards of the Stanthorpe district, where it attacks the branches of unhealthy trees and frequently bores into pruned branches or excavated trees. Within the wood the beetles make horseshoe-shaped tunnels which may be simple or branched, and in these the eggs are placed and the larvae develop. The life cycle may be completed in less than two months.

81. **similis** Ferrari, 1867: Borkenk.: p. 24.

Syns.—*Bostrychus ferrugineus* Boh.

Xyleborus submarginatus Blandford, 1896: Trans. Ent. Soc. Lond. 1896: p. 223.

Type localities.—Keeling Islands, also Tahiti.

Other records.—New South Wales: Wearne, Sydney (W. W. Froggatt), 16.12.23 ex white ash (Schedl 1936); Queensland: *Excoecaria dallachyana,* Imbil, July 1938; *Castanospermum australe,* also *Euroschinus falcatus,* Yarraman, Sept. 1948; *Erythrina vespertilio* Benth., East Haldon, Mar. 1950.

This insect occurs in New Guinea, Philippines and through Malaya to India. Adults bore into the wood of dying trees or felled logs and can penetrate well into the timber.

82. **solidus** Eichhoff, 1868: Berl. Ent. Z. 12: p. 151.

Type locality.—New Holland.

Other records.—New South Wales: southern forests, *Eucalyptus maculata;* northern forests, *Eucalyptus saligna;* Batlow district, *Eucalyptus dalrympleana* and *E. gigantea* (Froggatt 1927); Tamworth (A. M. Lea), Tenterfield (J. Miller), in cherry, Feb. 1892, Queanbeyan (A. M. Lea), Dorrigo (W. Herron), Brooklana, ex blue gum, Feb. 1924 (W. W. Froggatt), Bangabla, ex red gum, Mar. 1924 (W. W. Froggatt), Canterbury Vale (Cliff); Victoria (French) (Schedl 1936); Queensland: *Eucalyptus tereticornis,* Redland Bay, Aug. 1937; *Eucalyptus acmenioides,* Byfield, Oct. 1938, also Emu Vale, Feb. 1939, R. 8 Doongul, Oct. 1939; *Eucalyptus citriodora,* R. 8

Doongul, Jan. 1939; *Eucalyptus maculata,* Barakula, Oct. 1939; *Diploglottis australis* (G. Don) Radlk., Yarraman, May 1947 *Eucalyptus pilularis* Sm., Kabunga, Oct. 1942; Gayndah, Mar. 1941; St. Lawrence, 1949.

The beetles may penetrate through bark or directly into exposed wood of dying trees or felled logs. The entrance tunnel normally continues for several inches but may spread as two or three branches. In these as many as 20 full-grown larvae and pupae have been found. An unusual record of damage was a heavy attack on a rubber garden hose.

Schedl (1939) records this insect from Brazil.

83. **torquatus** Eichhoff, 1868: Berl. Ent. Z. 12: p. 146.

Type localities.—Cuba, Brazil, Porto Rico.

Other record.—Queensland: *Planchonella pohlmaniana,* Yarraman, May 1936.

Adults penetrate the bark and extend the tunnels into the wood. At the time of collection the beetles had tunnelled only a short distance and the full tunnel system was not investigated.

The insect is also recorded from many tropical countries.

84. **truncatus** (Erichson), 1842: Arch. Naturgesch. 8 (1); p. 212.

Syns.—*Tomicus truncatus* Erichson, 1842.
Amasa thoracica Lea, 1894: Proc. Linn. Soc. N.S.W. 8: p. 323.
Amasa truncata (Erichson): Froggatt 1925: Aust. For. J. 9: pp. 144-6.

Other records.—New South Wales: *Eucalyptus rostrata,* Forbes, May 1925; *E. saligna,* Ourimbah, Nov. 1925 (Froggatt 1927); South Australia: Kangaroo Is. and Lucindale (A. M. Lea); Tasmania: Huon River (Lea); Davenport (A. Simson); Queensland: Dalby (Mrs. F. H. Hobler) (Schedl 1936); *Eucalyptus maculata,* R. 446 Stapylton, July 1936, also Barakula, July 1938; *E. citriodora,* R. 8 Doongul, Aug. 1938; *E. acmenioides,* Emu Vale, Mar. 1939.

(*Note:* Listing of Dalby in New South Wales by Schedl (1936) is incorrect.)

This borer attacks exposed sapwood of living or felled trees. The beetle bores a short distance into the wood and excavates a "keyhole" cavity in which the eggs are laid and the larvae develop. The life cycle is completed in about three months.

85. **Xyleborus** sp. near **artegraphus** Schedl.

Queensland: A rainforest tree, Emu Vale, Mar. 1944.

86. **Xyleborus** sp.

Queensland: *Flindersia brayleyana,* Gadgarra, Apr. 1934 (J. H. Smith); *Castanospermum australe,* Wongabel, Mar. 1937.

Subfamily Unplaced.

XXXIII. Genus **DACTYLIPALPUS** Chapuis, 1873 (preprint 1869): Mem. Soc. Sci. Liege 3: p. 220.

Species occur in tropical countries.

87. **transversus** Chapuis, 1873 (preprint 1869): Mem. Soc. Sci. Liege 3: p. 220.

Type localities.—Malacca, Celebes.

Other records.—New South Wales: Batlow, Sydney, Feb. 1915 (W. W. Froggatt) (Schedl 1936); Queensland: Cape York (H. Hacker) (Schedl 1936).

This species occurs also in New Guinea and through to Indo-China.

OTHER SPECIES.

Xyleborus apertus Schedl, 1939: J. Fed. Malay States Mus. 18: p. 355.

Type localities and host.—"North Borneo: Koung, near Mt. Kinabalu, 1,300 feet, 15.III.1929, (H. M. Pendlebury); Malaya, Perak: Trolak For. Res., 6.II.1937, at light; Selangor: Sungei Buloh For. Res., 1.XII.1936, on log of *Shorea leprosula,* (F. G. Browne)."

This species is recorded as attacking brushwood in northern New South Wales by Richards (1953) from a single specimen identified by the Commonwealth Institute of Entomology, London. The differences between this species and *X. perforans* are slight and confirmation of the occurrence of this species in Australia is desirable before the record is definitely accepted.

ACKNOWLEDGEMENTS.

The Commonwealth Institute of Entomology has assisted with determinations of much of the Scolytid material and checked the type references. Officers of the Botany Section of the Department of Agriculture and Stock have helped with host identifications.

This assistance is gratefully acknowledged.

REFERENCES.

Beeson, C. F. C. 1929. Platypodidae and Scolytidae. *In* Insects of Samoa and other Samoan Terrestrial Arthropoda: Part 4: Coleoptera, Fasc. 4: 217-48. London: British Museum (Natural History).

Brimblecombe, A. R. 1945. The biology, economic importance and control of the pine bark weevil, *Aesiotes notabilis* Pasc. Qld. J. Agric. Sci. 2: 1-88.

———————. 1951. The prevention of borer attacks on hoop pine logs. Qld. J. Agric. Sci. 8: 69-105.

CALDWELL, N. E. H. 1946. Pinhole borers in deciduous fruit trees. Qld. Agric. J. 63: 282-3.

EGGERS, H. 1927. Neue Indomalayische Borkenkaser Ipidae. Treubia 9: 390-408.

FROGGATT, W. W. 1899. Insect pests. Agric. Gaz. N.S.W. 10: 74-6.

———————. 1924. Timber boring beetles, No. 1. Aust. For. J. 7: 228-30.

———————. 1925. Forest insects, No. 13. The island pinhole borer (*Xyleborus perforans* Wollaston). Aust. For. J. 8:232-4.

———————. 1926. The hairy pinhole borer, *Xyleborus hirsutus* Lea. Aust. For. J. 9:120-2.

———————. 1927. Forest Insects and Timber Borers. Sydney: Government Printer.

HADLINGTON, P. 1951. The bark beetles (Scolytidae). Tech. Notes N.S.W. For. Comm. Div. Wood Tech. 5: 27-30.

RICHARDS, M. 1953. Forest insects and wood destroying insects of New South Wales. Tech. Notes N.S.W. For. Comm. Div. Wood Tech. 6: 6-9.

SCHEDL, K. E. 1936. Scolytidae and Platypodidae, Contribution 35. The collection of the South Australian Museum. Rec. S. Aust. Mus. 5: 513-35.

———————. 1938. Scolytidae and Platypodidae, 48, Beitrag. Die Gattungen *Coccotrypes* Eichh., *Poecilips* Schauf., *Thamnurgides* Hopk., and *Dendrugus* Egg., nebst Beschreibung einer neuen Art. Ent. Ber. 10 (219): 8-12.

———————. 1939. Scolytidae and Platypodidae (Col.) 63, Beitrag. Mitt. Munch. Ent. Ges. 39: 565-85.

SWAN, D. C. 1942. The bark beetle *Hylastes ater* Payk. (Coleoptera, Scolytidae) attacking pines in South Australia. J. Dept. Agric. S. Aust. 46: 86-90.

———————. 1950. Bark beetle damage at Wirrabara State Forest. Unpublished report.

ADDENDUM.

Since the above list was compiled the following additional records have been noted.

Subfamily **HYLESININAE.**

XXXIV. Genus **CRYPTURGUS** Erichson, 1836: Arch. Naturgesch. 2: p. 60. Species occur in Europe, North Africa and North America.

Crypturgus sp.

Queensland: *Araucaria cunninghamii,* Elgin Vale, Feb. 1944.

Subfamily **IPINAE.**

Genus **COCCOTRYPES.** (See p. 40.)

Coccotrypes pilosulus Schedl, 1949: Tijdschr. Ent. 91: p. 118.

Type locality.—Queensland: Kuranda.

XXXV. Genus **CRYPHALOMORPHUS** Schaufuss, 1891: Tijdschr. Ent. 34: p. 12.

Species occur in several tropical countries.

Cryphalomorphus australis (Schedl), 1942: Mitt. Munch. Ent. Ges. 32: p. 175.

Syn.—*Lepicerinus australis* Schedl, 1942.

Type locality.—Australia.

A. H. Tucker, Government Printer, Brisbane.